Solid State

RAILROAD MICOR®

150.8-174 MHz

68P90012M75

INSTRUCTION MANUAL

MOTOROLA INC. Communications Division

Solid State

RAILROAD MICOR®

150.8-174 MHz

68P90012M75

MOTOROLA

CUSTOMER QUESTIONNAIRE

To the Reader of This Instruction Manual:

Motorola is engaged in a continuous program of improving its instruction literature. We believe that you can aid us in this program, so that we in turn can better help you service our equipment. To foster these aims, would you please answer the following questions:

First Fold

SCHEMATIC DIAGRAMS AND CABLING DIAGRAMS

First Fold

1. ☐ Are accurate and easy to follow
2. ☐ Contain minor errors
3. ☐ Contain major errors
4. ☐ Are difficult to follow

If you have checked any box except 1, please tell us what schematic diagrams, or portions thereof, were at fault, or enter other comments.*

_____

_____

68P85901D80-E

TEXT

1. ☐ Easy to follow – helps to service equipment
2. ☐ Would like more information on*

Second Fold

_____

Second Fold

_____

3. ☐ Some instruction sections are too long or superfluous such as*

_____

_____

4. ☐ Other comments*

_____

_____

_____

(continued on reverse side)

PARTS LIST

1. ☐ Are complete and accurate
2. ☐ Would like more information as follows*

_____

_____

ILLUSTRATIONS IN GENERAL

1. ☐ Are complete and accurate
2. ☐ Want more illustrations such as*

_____

_____

3. ☐ Some are superfluous such as*

_____

_____

The name of my instruction manual is:

_____

The part number of my instruction manual is:

_____

(This number will be found on the cover or on the title page)

My name is _____

Company _____

Address _____

City _____ State _____ Zip _____

Date _____

*Whenever possible, give complete model No. of equipment, and part No. of diagram or part No. of instruction section. This information is important.

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MOTOROLA

"MICOR"

SOLID-STATE
RAILROAD FM TWO-WAY RADIO
WITH "MICOR" "SENSITRON" RECEIVER
150.8-174 MHz 13.6 & 72 VOLT DC SYSTEMS
117 VOLT AC SYSTEMS

MOTOROLA INC. *Communications Division*
ENGINEERING PUBLICATIONS 1301 E. ALGONQUIN ROAD SCHAUMBURG, ILLINOIS 60172

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68P81012E10
Issue - C

GUARANTEED PERFORMANCE SPECIFICATIONS

GENERAL

		MODELS			
		R43RTE SERIES	R43RTA SERIES	R43RTH SERIES	R43RTB SERIES
INTERMITTENT MINIMUM RF POWER OUTPUT			45 W		
MAXIMUM FINAL INPUT POWER			90 W		
MAXIMUM BATTERY DRAIN	STANDBY	0.30 A @ 72 V DC 1.5 A @ 13.8 V DC	1.0 A @ 13.8 V DC	0.30 A @ 72 V DC	50 W @ 117 V RMS
	TRANSMIT	3.5 A @ 72 V DC 16.5 A @ 13.6 V DC	16.5 A @ 13.6 V DC	3.5 A @ 72 V DC	300 W @ 117 V RMS
DIMENSIONS		13" wide x 17-1/2" long x 5-1/8" high (including mounting base plate)			
WEIGHT		Approximately 38 lbs			
FREQUENCY RANGE		150.8-174 MHz			
METERING		A single-scale 0-50 microampere meter or Motorola Portable Test Set can be used to measure all circuits essential to tuning and servicing.			

TRANSMITTER

RF POWER OUTPUT	45 watts
OUTPUT IMPEDANCE	50 ohms
SPURIOUS & HARMONIC EMISSION	More than 85 dB below carrier per EIA Spec. RS152B, paragraph 4.
FREQUENCY STABILITY	Channel element maintains carrier within ±.0005% (±.0002% optional) from -30°C to +65°C ambient (+25°C ref).
MODULATION	16F3: ±5 kHz for 100% @ 1 kHz
AUDIO SENSITIVITY	0.36 V ±3 dB for 70% of maximum deviation at 1000 Hz
FM NOISE	65 dB below 60% of maximum deviation at 1000 Hz
AUDIO RESPONSE	+1, -3 dB/octave pre-emphasis characteristic from 300 to 3000 Hz
AUDIO DISTORTION	Less than 3% at 1000 Hz; 60% of maximum deviation

"SENSITRON" RECEIVER

CHANNEL SPACING		30 kHz	
EIA MODULATION ACCEPTANCE		±7 kHz minimum	
FREQUENCY STABILITY		Channel element maintains oscillator frequency within ±.0005% (±.0002% AFC optional) from -30°C to +65°C ambient (+25°C ref).	
INPUT IMPEDANCE		50 ohms	
		NO PREAMPLIFIER	WITH PREAMPLIFIER
SENSITIVITY	20 dB QUIETING	0.5 uV	0.25 uV
	EIA SINAD	0.35 uV	0.175 uV
SELECTIVITY (EIA SINAD)		-100 dB @ ±30 kHz	-95 dB @ ±30 kHz
EIA SINAD INTERMODULATION		-80 dB	-75 dB
SPURIOUS & IMAGE REJECTION		100 dB min.	90 dB min.
SQUELCH SENSITIVITY	CARRIER SQUELCH (adjustable)	0.25 uV or less at threshold	0.125 uV or less at threshold
	TONE-CODED SQUELCH ("AND" Type)	0.25 uV or less	0.125 uV or less
AUDIO OUTPUT		10 watts at less than 5% distortion (into an 8-ohm load at 1000 Hz).	

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

FCC LICENSE DESIGNATION

MAX. NO. OF FREQUENCIES	±.0005% & ±.0002% FREQUENCY STABILITY CHANNEL ELEMENT
4	CC3149
8	CC3150

FOREWORD

SCOPE OF INSTRUCTION MANUAL

This manual offers descriptive and service information for the radios described in it. Service diagrams, parts lists, and printed circuit board details are also included.

NOMENCLATURE

Motorola radio equipment is specifically identified by the model number on the nameplate.

NOTE

Be sure to use the entire model number when making inquiries about your equipment.

Identifiers have been assigned to chassis and kits. Use these identifiers when requesting information or ordering replacements.

PRODUCTION CHANGES

When production and engineering changes are incorporated into the equipment, a revision numeral is assigned to the chassis or kit affected.

Typical Example:
The Model TRD1432AA becomes
TRD1432AA-1 with the first revision.

This chassis number complete with revision numeral, if any, is stamped on the chassis at the time of production. The revision numeral becomes an integral part of the chassis identifier.

INSTRUCTION MANUAL REVISIONS

Changes which occur after an instruction manual is printed are described in the Instruction Manual Revision. These bulletins give the reader complete information on the change including pertinent parts listing data.

CAREFUL USE OF THE INSTRUCTION MANUAL AND THE MANY SUGGESTIONS CONTAINED IN IT WILL FURTHER INSURE PROPERLY INSTALLED AND MAINTAINED RADIO EQUIPMENT.

68P81002E32-F

PARTS AND SERVICE

REPLACEMENT PARTS ORDERING

ORDERING INFORMATION

Motorola maintains parts depots strategically located throughout the country. These facilities are fully equipped to give the finest service. Orders for all parts except crystals, channel elements, and "Vibrasender" and "Vibrasponder" resonant reeds should be sent to the nearest parts depot. Orders for crystals, channel elements and reeds should be sent to the factory address listed. Orders for instruction manuals should also be sent to the parts and service depots.

When ordering replacement parts, the complete number identification of the item must be used whether it be a component, kit or complete chassis. This will fix proper identification and assure delivery of the desired item. Complete number identification should also be used when requesting equipment information.

Crystal and channel element orders should specify the crystal or channel element type number, crystal frequency, carrier frequency, and the chassis model number in which the part is used.

Orders for "Vibrasender" and "Vibrasponder" resonant reeds should specify type number and frequency and should identify the owner/operator of the communications systems in which these items are to be used.

MOTOROLA INC.
Communications Division Parts Department
1313 E. Algonquin Road, Schaumburg, Illinois 60172 (312) 359-6550
Executive Offices: 1301 E. Algonquin Road, Schaumburg, Illinois 60172

U.S. ORDERS

WESTERN AREA PARTS
1170 Chess Drive, Foster City, San Mateo, California 94404
Phone: 415-349-3111 · TWX: 910-375-3877

MIDWEST AREA PARTS
1313 E. Algonquin Road, Schaumburg, Illinois 60172
Phone: 312-359-6550 · TWX: 910-693-1592

EAST CENTRAL AREA PARTS
12995 Snow Road, Parma, Ohio 44130
Phone: 216-267-2210 · TWX: 810-421-8845

EASTERN AREA PARTS
85 Harristown Road, Glen Rock, New Jersey 07452
Phone: 201-447-4000 · TWX: 710-988-5602

PACIFIC SOUTHWESTERN AREA PARTS
2333 Utah Avenue, El Segundo, California 90245
Phone: 213-644-1101 · TWX: 910-348-6278

SOUTHWESTERN AREA PARTS
3320 Belt Line Road, Dallas, Texas 75234
Phone: 214-241-2151 · TWX: 910-860-5505

SOUTHEASTERN AREA PARTS
P. O. Drawer 1, Forest Park, Georgia 30050
Phone: 404-762-6183 · TWX: 810-751-8300

CANADIAN ORDERS

Canadian Motorola Electronics Company
Parts Department
3125 Steeles Avenue East Willowdale, Ontario
Phone: 416-499-1441 · TWX: 610-492-2713
Telex: 02-29944LD

ALL COUNTRIES EXCEPT U.S. AND CANADA

MOTOROLA INC.	MOTOROLA Americas Inc.
International Parts 1313 E. Algonquin Road Schaumburg, Illinois 60172 U.S.A. Phone: 312-359-6550 TWX: 910-693-1592 or 1599 Telex: 722443 or 722424 Cable: MOTOL	1313 E. Algonquin Road Schaumburg, Illinois 60172 U.S.A. Attn: International Parts Phone: 312-359-6550 TWX: 910-693-1592 or 1599 Telex: 722443 or 722424 Cable: MOTOL

FACTORY ADDRESS FOR CRYSTAL, CHANNEL ELEMENT AND RESONANT REED ORDERS

AIR MAIL ORDERS	REGULAR MAIL ORDERS AND CORRESPONDENCE
Motorola, Inc. Component Service Department P. O. Box 66191 O'Hare International Airport Chicago, Ill. 60666	Motorola, Inc. Component Service Department 2553 Edgington Street Franklin Park, Illinois 60131

SERVICE

Motorola provides a nation-wide service organization. Through its maintenance and installation program Motorola makes available the finest service to those desiring reliable continuous communications on a contract basis.

The largest service organization specializing in mobile communications is Motorola's National Service Organization. Over 800 strategically located, adequately staffed and trained, independently owned and operated stations manned with several thousand FCC licensed personnel constitute the sub-contracting force.

The administrative forces of area and district service managers and district service representatives are in the direct employ of Motorola.

For your contract service requirements, please contact your local Motorola representative or write to:

National Service Manager
Motorola Communications Division
1301 E. Algonquin Road, Schaumburg, Ill. 60172

68P81001E43-M

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MOTOROLA

BASIC RADIO SET MODEL CHART
FOR
150.8-174 MHz
RAILROAD "MICOR"
FM TWO-WAY RADIO SETS

CODE:

- [X] - ONE ITEM SUPPLIED.
- [O] = ONE ITEM REQUIRED FOR EACH OPERATING FREQUENCY UP TO FOUR. NOT PART OF BASIC RADIO SET MODEL.
- [▨] = ONE ITEM SUPPLIED PER TEN (OR LESS) RADIO SETS.
- [●] = ONE ITEM REQUIRED FOR EACH OPERATING FREQUENCY UP TO EIGHT. NOT PART OF BASIC RADIO SET MODEL.

* REPRESENTS A SERIES OF MODELS AND NOT A SPECIFIC MODEL. THE SPECIFIC MODEL NUMBER STAMPED ON THE CHASSIS CORRESPONDS WITH A SPECIFIC CARRIER FREQUENCY RANGE.

ITEM	DESCRIPTION	R43RTE-1190AA	R43RTA-1190AA	R43RTH-1190AA	R43RTB-1190AA	R43RTE-3190AA	R43RTA-3190AA	R43RTH-3190AA	R43RTB-3190AA	R43RTE-1120AA	R43RTA-1120AA	R43RTH-1120AA	R43RTE-3120AA	R43RTA-3120AA	R43RTH-3120AA
	DESCRIPTION	CARRIER SQUELCH (1 TO 4 FREQ)	13.6 74 V DC POWER SOURCE	13.6 V DC POWER SOURCE	72 V DC POWER SOURCE	117 V AC POWER SOURCE	"PRIVATE-LINE" TONE-CODED SQUELCH (1 TO 4 FREQ)	13.6 74 V DC POWER SOURCE	13.6 V DC POWER SOURCE	72 V DC POWER SOURCE	117 V AC POWER SOURCE	CARRIER SQUELCH (1 TO 8 FREQ)	13.6/72 V DC POWER SOURCE	13.6 V DC POWER SOURCE	72 V DC POWER SOURCE	"PRIVATE-LINE" TONE-CODED SQUELCH (1 TO 8 FREQ)	13.6 74 V DC POWER SOURCE	13.6 V DC POWER SOURCE	72 V DC POWER SOURCE
	MODEL														
TLD5282A	EXCITER (FORMERLY TLD8262B)	X	X	X	X	X	X	X	X	X	X	X	X	X	X
*TLD1630A	POWER AMPLIFIER	X	X	X	X	X	X	X	X	X	X	X	X	X	X
TLD8290A	POWER CONTROL BOARD	X	X	X	X	X	X	X	X	X	X	X	X	X	X
K1007A	CHANNEL ELEMENT, TRANSMITTER	O	O	O	O	O	O	O	O	●	●	●	●	●	●
TLN4295A	ANTENNA SWITCH	X	X	X	X	X	X	X	X	X	X	X	X	X	X
*TLD5270A	RECEIVER RF & IF BOARD (FORMERLY TLD8270A)	X	X	X	X	X	X	X	X	X	X	X	X	X	X
TRN6003A	RECEIVER AUDIO & SQUELCH BOARD (FORMERLY TLN4310A)	X	X	X	X	X	X	X	X	X	X	X	X	X	X
TLN4290B	AUDIO POWER AMPLIFIER	X	X	X	X	X	X	X	X	X	X	X	X	X	X
K1005A	CHANNEL ELEMENT, RECEIVER	O	O	O	O	O	O	O	O	●	●	●	●	●	●
TLN4574A	CONTROL BOARD	X	X	X	X	X	X	X	X	X	X	X	X	X	X
TLN4579A	FRONT CONNECTOR BOARD	X	X	X	X	X	X	X	X	X	X	X	X	X	X
TLN4293B	"PRIVATE-LINE" ENCODER					X	X	X	X				X	X	X
TLN6824A	"VIBRASENDER" RESONANT REED					X	X	X	X				X	X	X
TLN4294B	"PRIVATE-LINE DECODER					X	X	X					X	X	X
TLN8381A	"VIBRASPONDER" RESONANT REED					X	X	X	X				X	X	X
TLN4577A	TRANSIENT FILTER BOARD	X		X		X		X		X		X	X		X
TLN4576A	HIGH END REGULATOR BOARD	X	X	X	X	X	X	X	X	X	X	X	X	X	X
TPN6064A	13.6 V DC BOARD	X	X			X	X			X	X		X	X	
TPN6065A	72 V DC BOARD	X		X		X		X		X		X	X		X
TLN4578A	FUSE BOARD		X				X				X			X	
TLN4580A	MODEL HARDWARE KIT					X	X	X	X				X	X	X
TLN4301A	TUNING TOOLS KIT	/	/	/	/	/	/	/	/	/	/	/	/	/	/
TLN4677A	MODEL HARDWARE KIT	X	X	X	X					X	X	X			
TLN4838A	RECTIFIER & FILTER BOARD				X				X						
TLN4871A	STRAPPING BOARD				X				X						
TPN6006A	110 V DC BOARD				X				X						
TLN4864A	"PRIVATE-LINE" DECODER								X						
TLN4914A	MOUNTING HARDWARE FOR 8-FREQUENCY BOARD									X	X	X	X	X	X
TLN4872A	8-FREQUENCY CIRCUIT BOARD									X	X	X	X	X	X

EPS-6952-C

ACCESSORY CHART

MODEL NUMBER	DESCRIPTION
K1006A	Channel Element, Receiver, ±.0002% stability
TLN4440A	AFC Amplifier, Receiver
TLD8752A	RF Preamplifier, Receiver
K1036A	Channel Element, Transmitter, ±.0002% stability
TLN1007C	Mounting Rack, Standard AAR
TCN6108AJ, BJ	Control Head, Non-Reverting, Standard AAR, Four-Channel
TCN6109AJ, BJ	Control Head, Channel Reverting, Standard AAR, Four-Channel
TCN6108AK, BK	Control Head, "Private-Line", Non-Reverting, Standard AAR, Four-Channel
TCN6109AK, BK	Control Head, "Private-Line" Channel Reverting, Standard AAR, Four-Channel
TCN1057AJ, BJ	Control Head, Single-Tone, Standard AAR, Four-Channel
TCN1100A	Control Head, Single-Tone, Channel Reverting, Standard AAR, Four-Channel
TCN6146A	Control Head, Non-Reverting, Standard AAR, Eight-Channel
TCN6148A	Control Head, Channel Reverting, Standard AAR, Eight-Channel
TCN6147A	Control Head, "Private-Line" Non-Reverting, Standard AAR, Eight-Channel
TCN1099A	Control Head, Single-Tone, Standard AAR, Eight-Channel
TMN6002D	Handset, Dynamic Type, with Coiled Cord
TMN6043B	Handset, Dynamic Type with Armored Cable
TAD6010A	Antenna, Rigid Railroad
TAD6020A	Antenna, Condulet Mounted
TKN6044A	Bench Test Cable Kit
TSN6001A	Speaker, Outdoor, Standard AAR
TLN6075C	Remote Control Unit, Standard AAR
TLN6076A	Footboard Control Unit, Standard AAR
TLN1361A	Time-Out Timer
TMN6082A	Handset, Dynamic Type, with Coiled Cord
TMN6083A	Handset, Dynamic Type, with Armored Cable

1. INTRODUCTION

The Motorola "Micor" railroad radio sets are FM two-way radios which operate from a 13.6-volt dc or 72-volt dc power source. These radios are fully solid-state units incorporating integrated circuits. Reed switches are used for push-to-talk and antenna switching functions.

The radio sets are multi-frequency, operating in the 150.8 to 174 MHz range, with 45-watts transmitter rf output. Refer to the MODEL CHART at the front of this manual for a list of available models. In all models, the receiver provides 10-watts of audio output at less than 5% distortion. Models are available with carrier squelch or "Private-Line" tone-coded squelch operation.

2. PHYSICAL DESCRIPTION

Virtually all components are mounted on circuit boards which are easily removed and replaced without unsoldering leads. A control circuit board runs the length of the radio in the center. Other circuit boards plug directly into the control board, which provides interconnections via circuit board plating instead of wiring. The few remaining wire connections may be unplugged and reconnected easily; no unsoldering and resoldering is required. The transmitter circuits are on one side of the radio set and receiver circuits are on the opposite side. Transmitter signals are generated in the plug-in oscillator modules (channel elements) at the back of the radio and are progressively routed toward the front of the radio set where the final transmitter output signal is taken from the antenna connector. The receiver signals are likewise routed from back to front of the radio set. The final audio output is developed at the front of the radio. The audio power amplifier's transistor board is mounted to the side of the radio set for good heat dissipation.

A variety of circuit boards are used to make up the power supply. These boards interconnect directly with one another and are mounted on the bottom side of the radio set. Refer to the model chart at the beginning of this manual and to the power supply section for exact power supply configurations.

The housing has highly efficient, finned radiators to dissipate heat generated in the transmitter and power supply so that venting the housing is unnecessary. This keeps components free of dust, etc., and eliminates servicing resulting from entrance of contaminants through a vented housing.

The Standard AAR mounting rack, the Standard AAR control head with handset, and the antenna are required accessories. Cables from each of these units are connected into the radio set by multi-connector terminal boards in the mounting rack. Extended local control is possible, since the control head is mounted separately from the radio set.

3. SERVICING FEATURES

Specific servicing and maintenance information is given for each circuit board in that board's particular section in the manual. In addition a maintenance section is also provided. Some of the more general servicing features are:

-- Integrated Circuits - Fewer components and more reliable components mean less servicing.

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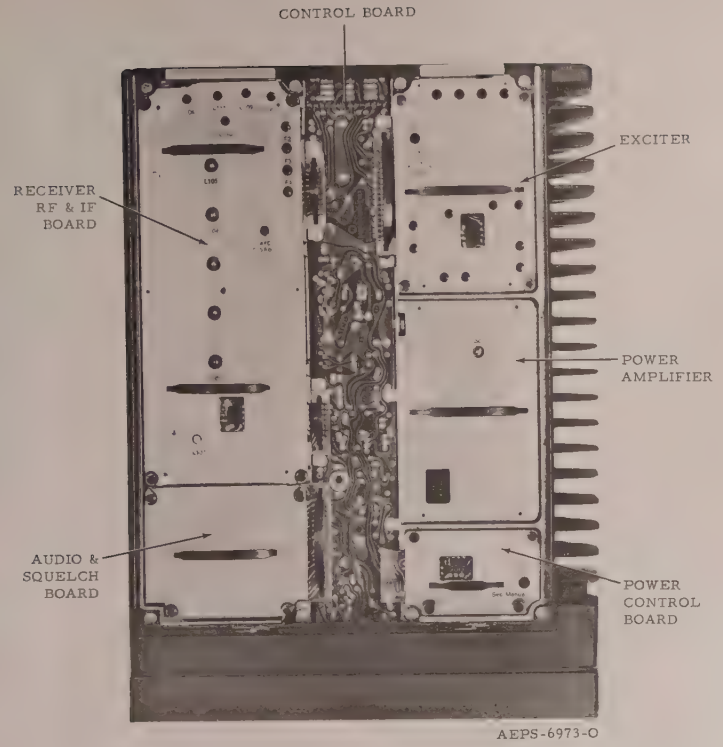
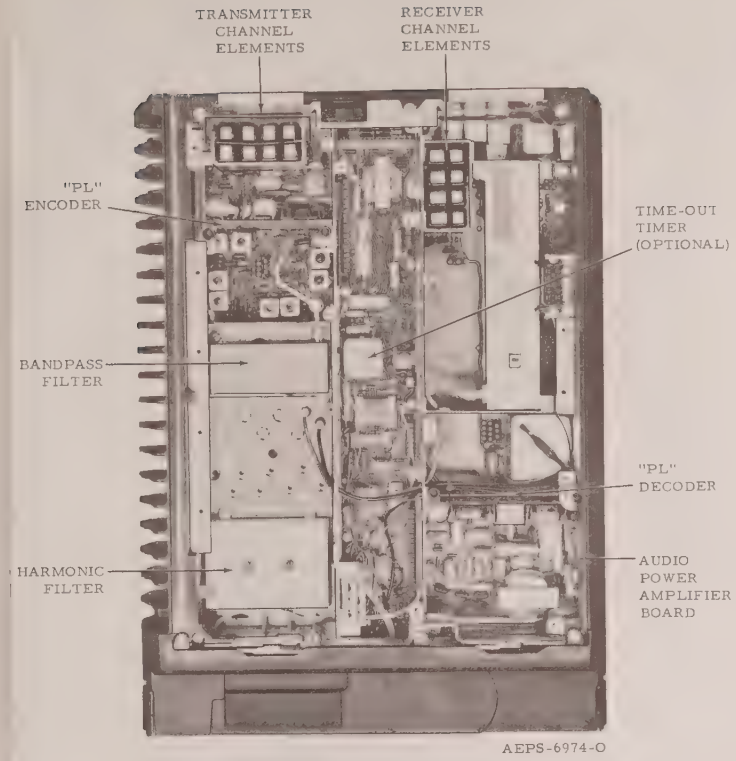
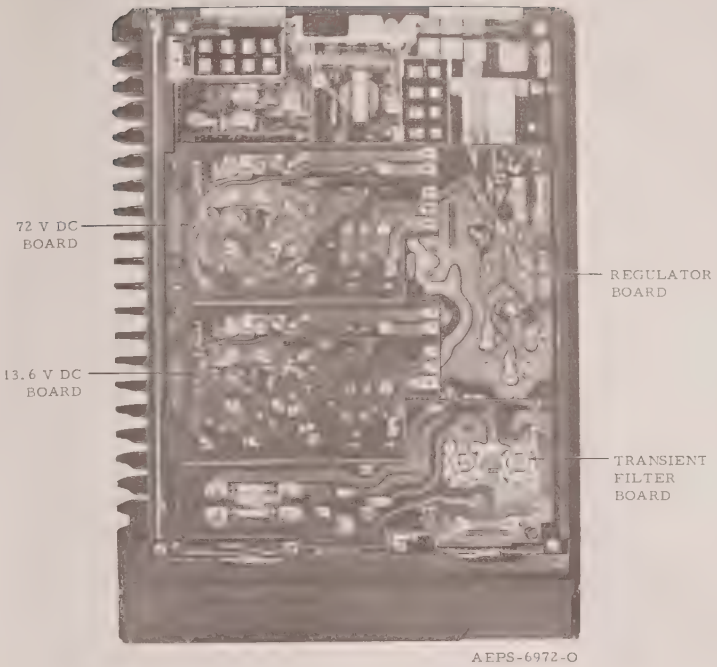


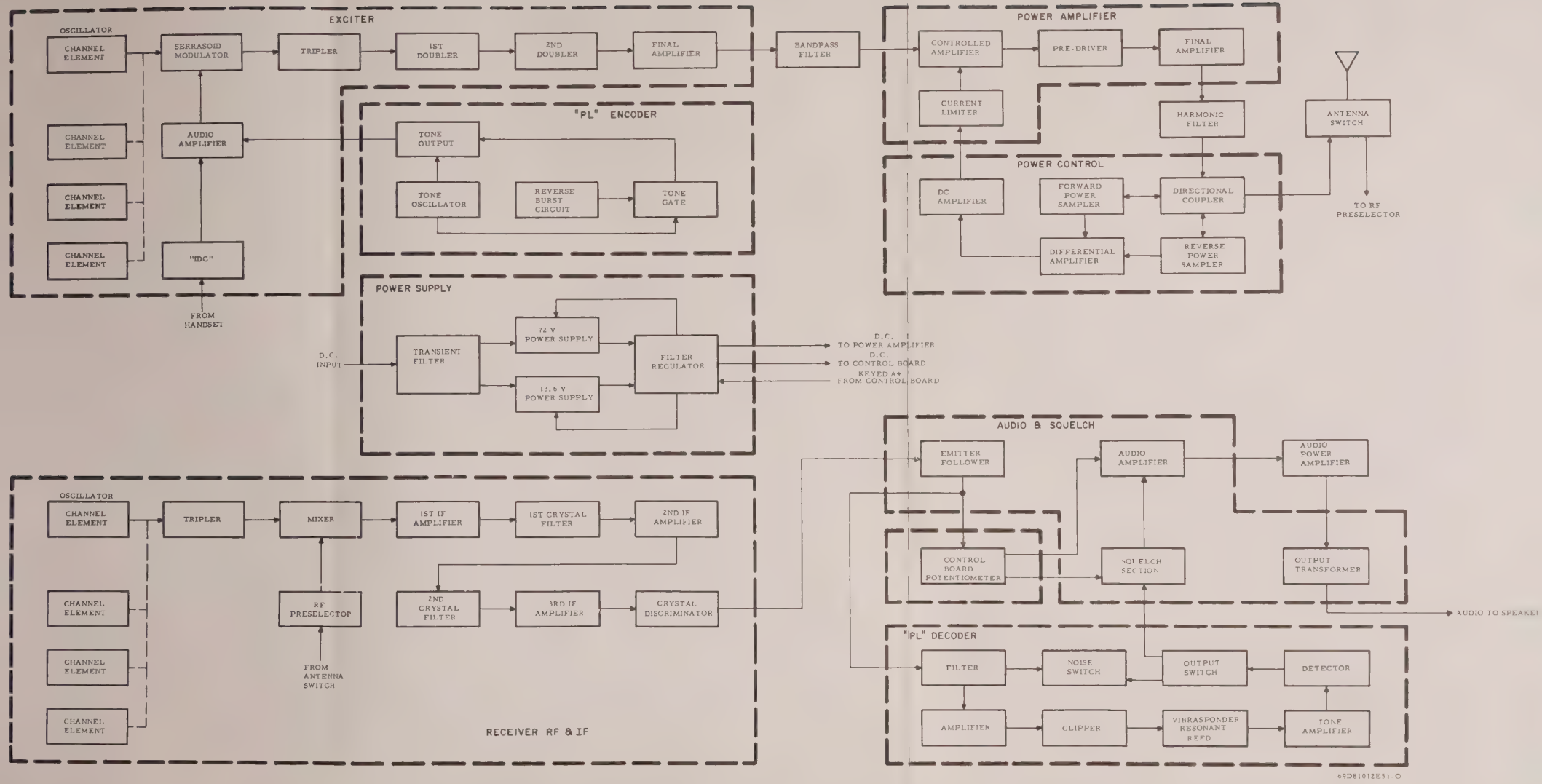
Radio Set Circuit Board Locations



Radio Set Major Component Locations



Power Supply Circuit Board Locations



DESCRIPTION

Radio Set
Functional Block Diagram
Motorola No. 69D81012E51-O
7/29/74-NPC

-- Few Wires - Broken and loose wire connections are eliminated as a source of trouble.

-- Modular Construction - Circuit boards can be removed and replaced in seconds. Spare circuit boards may be carried by a technician and defective boards replaced to quickly return radios to service. The entire complement of boards interconnected to form the power supply can be physically detached from the radio as a unit and still remain in operation to facilitate servicing.

-- Eight Metering Receptacles - Metering receptacles in the exciter, power amplifier, power supplies, regulator, power control board, receiver and control board allow a Motorola portable test set to check over 30 major test points for rapid isolation of trouble. A microphone may be connected to the test set and the speaker in the test set used for operation of the radio set during testing.

-- Alignment - All receiver and transmitter alignment is performed from the top of the radio set. Crystal filters in the receiver i-f section eliminate most i-f alignment adjustments. Transmitter power output may be measured on a Motorola portable test set; no additional test equipment is required for transmitter alignment.

-- Netting - A set of NET contacts is provided to simultaneously activate the rf circuits of the receiver and exciter. This feature permits adjustment of all radios on a network to the same frequency. It is activated by inserting the radio key (or any other shorting device) between the two contacts.

4. TRANSMITTER

The transmitter generates a frequency modulated rf carrier signal of 45-watts, and consists of the following items:

-- Channel Element - An unheated, temperature-compensated crystal oscillator plug-in module (channel element) provides a stable fundamental rf frequency for the transmitter. One channel element is used for each transmitter frequency.

-- Exciter - The exciter provides the low power excitation signal for the transmitter. An "IDC" (Instantaneous Deviation Control) circuit amplifies and limits audio signals from the microphone to prevent over deviation. The serrasoid modulator produces phase modulation of the channel element output signal. Integrated circuits are used in the IDC and modulator stages. Multipliers in the exciter multiply the channel element frequency 12 times to generate the carrier frequency signal(s) in the 150.8-174 MHz band.

-- Bandpass Filter - The bandpass filter couples 150.8-174 MHz signals from the exciter to the power amplifier and attenuates any harmonics outside this band.

-- Power Amplifier - The lower power output of the exciter is amplified to the rated power output of the transmitter in this solid-state power amplifier. Class C amplifiers are used which are cut off until signal drive is applied. A controlled amplifier stage regulates the amount of signal drive to prevent over-dissipation in the final amplifier stages. An input from the power control board controls the amount of gain.

-- Harmonic Filter - The low pass harmonic filter passes the 150.8-174 MHz band carrier signal and attenuates all harmonics from being radiated.

-- Power Control Board - The power control board automatically and instantaneously regulates the transmitter output power. It maintains output power when source voltage varies, and progressively reduces power when temperature or VSWR increase. The output of the board is applied to the controlled amplifier stage in the power amplifier to regulate the amount of gain.

5. "MICOR" "SENSITRON" RECEIVER

The receiver accepts rf carrier signals on a specific channel in the 150.8-174 MHz range and provides voice audio in the 300-3000 Hz range. The receiver consists of the following items:

-- Channel Element - A plug-in crystal oscillator module (channel element) provides stable frequency control for each frequency of operation.

-- Receiver RF & IF Board - The single-conversion superheterodyne FM receiver includes five rf preselectors (tuned cavities) and two crystal filters for excellent selectivity. Two integrated circuit i-f amplifiers and limiters give high sensitivity. A crystal discriminator demodulates the audio directly from an 11.7 MHz i-f signal.

-- Audio & Squelch and Audio Power Amplifier Boards - Up to 10-watts of audio power at less than 5% distortion is provided by this circuit. When no messages are being received, the squelch circuit turns off the audio amplifiers to eliminate annoying noise in the speaker. A squelch tail eliminator circuit prevents the noise burst at the end of a message for strong signals. For weak signals, the circuit is automatically inhibited to prevent loss of portions of messages. The audio power amplifier transistors are mounted on a separate circuit board and aluminum heat sink for good heat dissipation.

6. "PRIVATE-LINE" TONE-CODED OPERATION

This type of operation permits private communications on crowded radio communication channels. Several "Private-Line" (PL) networks can use the same rf carrier frequency in the same area if each network uses a different PL tone frequency. The PL tones are in the 67-210 Hz range, which is below the 300-3000 Hz voice frequency range used in radio communication equipment.

The transmitters are modulated by a continuous sub-audible PL tone in addition to the voice modulation. The tone is generated by a PL encoder, which is a plug-in circuit board in the transmitter. The receivers accept only signals that are modulated with the specific PL tone frequency. Signals without the tone or with a different tone are not heard. Only messages from your own PL network are heard. A PL decoder, which is also a plug-in circuit board in the receiver, disables the audio circuits of the receiver until the proper tone is received. A filter blocks the tone from the speaker.

The PL decoder may be bypassed, if desired, to monitor all on-frequency signals. Since the operator cannot hear all on-frequency signals unless he monitors the channel, it is necessary to do so before transmitting to avoid interfering with other users.

NOTE

The Motorola Systems Engineering Department assigns the PL tone frequencies to prevent duplicate or interfering tones from being used in the same area. Consult them before changing tones or adding new ones. All "Private-Line" users will enjoy better performance.

7. CONTROL CIRCUIT

A control circuit board interconnects the other circuit boards of the radio set. It includes a +9.6-volt regulator which supplies power to the receiver and exciter. The control board also contains the volume and squelch controls, and the push-to-talk reed switches which switch 9.6 volts, A+, and A- to key the transmitter. The antenna switch also uses reed switches to transfer the antenna connection from the receiver to the transmitter. A socket for a time-out timer (optional accessory) is also located on the control board. Additional pins on the control board permit accessories or special circuits to be added without requiring solder connections.

8. POWER SUPPLIES AND FILTERING

A set of four, interconnected, plug-in circuit boards is mounted on the bottom side of the radio. These boards provide for operation from a 13.6-volt dc or a 72-volt dc supply line, as well as providing transient filtering and voltage regulation. Input power is routed from the front connector via cables to the transient filter and then to the power supply. Power is then routed through a high-end regulator and distributed to the radio set through the control board.

The transient filter board allows the radio to operate continuously, in either the standby or transmit mode, when very high voltage spikes are present on the locomotives supply lines.

Both the 13.6-volt and the 72-volt supplies use silicon transistors and diodes. Most of these are connected to the heat sink, along the side of the housing, to efficiently dissipate heat generated during operation.

The four boards that make up the power supply can be lifted out as a single unit to facilitate servicing, and still remain in operation using a service adapter cable.

9. REQUIRED ACCESSORIES

a. Standard AAR Control Head

The Motorola railroad control heads listed in the subsequent model chart provide control facilities for AAR railroad radio sets. These control heads can be used with installations operating from a primary power source the same as that of the radio set. Each unit includes a

channel selector switch for multi-frequency operation. A five-inch speaker is mounted in the housing. An AAR microphone receptacle is provided for a telephone type handset.

The housing consists of two hinged sections of cast aluminum. The units are ruggedly constructed to withstand shock and vibration. Threaded openings (3/4" pipe thread) are provided at the top and bottom for connection of conduit.

Automatic channel reverting models return to a pre-selected channel when the handset is hung up.

"Private-Line" models include a "PL" ON-OFF switch. With the switch in the ON position, transmissions are coded with a "Private-Line" tone and messages are received only from other transmitters sending the same "Private-Line" tone. In the OFF position, the "Private-Line" circuits are disabled and all on-frequency transmissions can be heard.

The pilot light dimmer circuit automatically controls the brilliance of the blue (transmit) pilot light and the channel indicator lights mounted on the control head. In bright daylight, the lights glow brightest to insure visibility. The lights become progressively dimmer to reduce excessive glare as daylight changes to darkness. External illumination is sampled through a panel in the upper portion of the control head and acts upon a light dependent resistor which is mounted behind the panel.

b. Handsets

The TMN6002D and TMN6043B Dynamic Handsets are exactly the same except that the TMN6043B uses an armored cord and the TMN6002D uses a standard neoprene coiled cord. The connector is an AAR specified type, CAN3102-14S-6S). A built-in transistorized preamplifier with a low output impedance (500-ohms at 1000 Hz) is contained in the microphone cartridge. Frequency response is essentially flat between 300 and 3000 Hz and the microphone will operate satisfactorily over an ambient temperature range of -30°C to +65°C. The earphone impedance is 125 ohms ±10%; at 1000 Hz.

The dynamic cartridge requires input power only when the push-to-talk switch is pressed. It does not load the associated power source otherwise. Contacts on the switch connect the cartridge into the circuit when the bar is pressed. The switch mounting plate is chrome plated and "Nylock" mounting screws are used.

c. Mounting Rack

The Model TLN1007C Mounting Rack permits mounting the radio set to a horizontal surface. It provides distribution of power and control functions by external cables which are routed to terminal board connections. A multi-conductor cable terminated in a 23-pin connector provides the necessary cabling from the terminal board in the mounting rack to the radio equipment.

Two clevis assemblies, one on either side of the equipment at the front of the rack, provide a sturdy hold-down device for the radio set. Brackets for a padlock are used to prevent unauthorized personnel from fampering with the equipment. Plug buttons are included to cover the conduit holes not used in the installation.

d. Antennas

Two types of mobile antennas are available for use with the radio set:

(1) TAD6010A Rigid Railroad Antenna

This item is a folded quarter-wave antenna of rugged construction. The antenna has a nominal input impedance of 52 ohms and operates at dc ground potential. The outer conductor is heavy gauge, silver plated tubing.

(2) TAD6020A Condulet Mounted Antenna

This unit is a quarter-wave whip-type antenna with a nominal input impedance of 52 ohms. The antenna base is mounted in a condulet box to permit complete weatherproof enclosure of the rf connectors. A conical neoprene cover completely encloses the antenna base insulator assembly. This minimizes the effects of dirt or soot deposited on the insulator and increases the impedance of the leadage path from the antenna rod to ground. Any standard 52-ohm antenna may be used for land station installations.

10. OPTIONAL ACCESSORIES

Additional accessories are available for the railroad "Micor" radio set. These items may be factory installed if purchased at the same time as the radio set or added later. Other accessories will become available after the printing of this manual; consult your Motorola sales representative for a complete list of currently available accessory items.

a. High Stability Channel Elements

Model K1036A Transmitter Channel Elements are available for ±.0002% frequency stability.

High stability (±.0002%) receiver operation requires special channel elements and a plug-in AFC amplifier module. Together, the units provide AFC (automatic frequency control) to keep the receiver precisely "on-frequency". Model numbers of the optional equipments are:

K1006A Receiver Channel Element (AFC)
TLN4440A AFC Amplifier

b. Time-Out Timer

The Model TLN1361A Time-Out Timer is a plug-in module which can be inserted into the railroad "Micor" radio set without additional modifications. It turns off the transmitter after approximately 60 seconds continuous operation. An alert tone in the speaker warns the operator that the transmitter has turned off. The timer is immediately reset when the transmitter is unkeyed.

c. TKN6044A Bench Test Cable Kit

This kit provides interconnections for bench testing of railroad radio sets. It may be used with Standard AAR models when removed from the mounting rack.

d. TSN6001A Speaker

This unit is a rugged, outdoor type speaker. A 16-ohm speaker with a 500-ohm matching transformer is included.

e. TLN6076A Footboard Control Unit

This unit provides operation of railroad radio equipment from the exterior of a locomotive or railroad car. Push-to-talk operation via a separate combination speaker-microphone (the TSN6001A Speaker is recommended), is accomplished by foot, knee, or hand operation of the hinged cover of the control unit. Thus, a crewman stationed on the exterior of the train can control the radio equipment.

f. TLN6075C Remote Control Unit

This remote control unit permits the radio set to be used as a remotely controlled base station. The unit is located at the radio set site to terminate 500/600-ohm control lines from the operator's position at a remote control console and convert dc control currents to transmitter keying, frequency selection, etc. Facilities are also provided for local control of the radio set from the remote control unit. This unit may be used with one- and two-frequency carrier squelch installations only.

g. TLD8752A RF Preamplifier

This rf preamplifier may be used in areas where increased operating range of the receiver is required. It increases the 20 dB quieting sensitivity of the receiver by 6 dB to 0.125 uV.

1. UNPACKING AND INSPECTION

Use care when unpacking and handling this radio equipment. Open the shipping carton and carefully remove the individually packaged components. Check contents to be sure all items have been included.

Inspect the equipment thoroughly as soon as possible after delivery. If any part of the equipment has been damaged in transit, report the extent of damage to the transportation company immediately.

2. PRE-INSTALLATION

This equipment has been accurately adjusted at the factory for optimum performance. However, it is possible that units may have been dropped or otherwise severly mishandled while in transit. Therefore, prior to making the installation, it is recommended that the transmitter and receiver be bench checked for proper meter readings. If these preliminary checks indicate that any of the circuits are out of alignment, the entire unit should be completely realigned.

If realignment is necessary, refer to the alignment procedure in this instruction manual.

FCC REGULATIONS

FCC regulations state that:

1. Radio transmitters may be tuned or adjusted only by a person holding a 1st or 2nd class commerical radiotelephone operator's license or by personnel working directly under his immediate supervision.
2. The rf power output of a station shall be no more than required for satisfactory technical operation considering the area to be covered and the local conditions.

Before proceeding with the actual installation a definite layout for the exact location of each unit and the method to be used for mounting must be determined. Complete mounting dimensions and inter-unit cabling for the Standard AAR radio sets and accessories are illustrated on the following diagrams.

a. Antenna

The antenna should be located as high as possible and still be able to clear obstacles on the right of way. A suitable ground plane must be provided--usually the metal top of a caboose or locomotive cab will serve. If the antenna is to be mounted on a wooden structure, a metal sheet at least 35 inches in diameter should be attached to the mounting surface. The metal sheet should be grounded to the antenna mounting base. The antenna should be located, if possible, at least 17 inches from any protruding structural member of the train that might cause shadow effect.

The RG-8/U transmission line from the antenna to the radio equipment should be made as short as possible. The transmission line may be enclosed in a 1/2-inch or 3/4-inch conduit to protect it from any possible damage.

b. Radio Set Housing

Base plate and housing installation and dimensional details are illustrated on the accompanying detail.

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c. Control Head

The mounting location for the control head should be selected so that the speaker in the control head faces the operator and that the handset is within easy reach of the operator. Control head mounting dimensional details are illustrated on an accompanying detail.

(1) Four-Channel Models

The control heads are shipped from the factory mechanically arranged for two-frequency operation. The control head is capable of up to four-frequency operation. To restrict the use of the control head to one-frequency operation remove the knob on the channel selector switch by loosening the "Allen" set screw using the wrench supplied. Move the channel stop screw from the center position to the threaded hole on the right. For three-frequency operation move the channel stop screw to the threaded hole on the left. For four-frequency operation, remove the stop screw. When the channel selector knob is replaced, place the knob in a position so the set screw contacts the flat spot on the shaft when it is tightened. Refer to detail.

The reverting type control heads are wired at the factory for channel 1 reverting. If another channel is desired for reverting, the white wire connected to terminal TB1-11 and the red-green wire connected to terminal TB2-21 should both be relocated to change the reverting channel. Make the connections as shown below.

Reverting Channel	White Wire Terminal	Red-Green Wire Terminal
F1	TB1-11	TB2-21
F2	TB1-12	TB2-22 or *TB1-6
F3	TB2-13	TB2-23
F4	TB2-14	TB2-24

*In installations using control heads wired to comply with AAR specifications for terminal designations, connect the red-green wire to terminal TB1-6.

For eight-channel models the reverting-group must also be selected in addition to selecting the reverting channel as shown in the above chart. Make the reverting group connections as shown below.

Reverting Group	Blue-Yellow Wire Terminal	Red-White Wire Terminal
A	TB1-3	TB2-16
B	TB1-15	TB2-19

d. 13.6- or 72-Volt Power Connections

It is recommended that the power input leads to the mounting rack be connected as closely to the battery terminals as possible on the battery side of the locomotive main power switch. To further protect the radio equipment and power input leads, it is recommended that a double-pole, double-throw switch be placed in series with both primary input leads. This is especially important to protect the radio set against megger tests and inductive field decay voltage which may appear when the main battery switch is operated.

CAUTION

Polarity of the power input leads must be observed. Reverse polarity protection diodes are located in the radio set; the one used in the 13.6 volt input causes a 20-ampere line fuse to blow, and the one used in the 72-volt input causes the 6-ampere line fuse to blow. The line fuses are located in the power supply. Refer to the Installation and Intercabling Diagram for proper polarity of power connections.

e. 117-Volt AC Power Connections

For radio sets equipped for operation from the 117-volt ac source, the hot lead must be connected to TB2-3 and the common lead must be connected to TB1-1. These radios may be powered from a 13.6-volt dc source during emergency operation. The 13.6-volt dc power positive (+) lead must be connected to TB1-2 and the negative (-) lead must be connected to TB2-5. Note that the maximum power drain during emergency operation with the transmitter turned on is 16.5A.

3. INSTALLATION

A multi-conductor cable, terminating in a 23-pin cable connector provides the necessary cabling from the terminal boards in the mounting rack to the radio set. This multi-conductor cable (W1) is supplied with the mounting rack.

As shown on the Installation & Intercabling Detail, 12 leads are required to interconnect the mounting rack terminal boards TB2 and TB3 to the associated control head. The 12 leads (not supplied) should be routed from the mounting rack to the control head via conduit (not supplied) as shown on the pictorial illustration. A 12-conductor vinyl-jacketed cable recommended for these connections

is available on separate order. This inter-unit radio cable can be obtained from the Motorola Parts Department, 1875 Greenleaf Ave., Elk Grove Village, Illinois 60007 by ordering Motorola Part No. 30C850298. Length required must be specified.

4. PROVISIONS FOR MULTIPLE-FREQUENCY OPERATION

a. General

"Micor" Railroad Radio is capable of operation on either one to four or one to eight frequencies. To increase the number of operating frequencies, two steps are required:

(1) Plug in the additional channel elements.

(2) Move the frequency selector switch stops to allow it to rotate to more positions.

b. Channel Elements

Refer to the circuit board diagrams for correct locations of the channel elements for each frequency. Frequency and deviation must be checked for each new transmitter frequency and the radio should be netted for optimum performance. Refer to the applicable ALIGNMENT PROCEDURES and IDC ADJUSTMENT PROCEDURE in this manual to accomplish these checks.

c. Frequency Selector Switch

(1) Four-Channel Models

A mechanical stop on the frequency selector switch on the control head should be set to prevent rotation to unused positions. For example, if a radio set is equipped with enough channel elements for two-frequency operation, the switch stop should be set to prevent rotation to the F3 and F4 positions. When a frequency is added, the mechanical stop must be reset to permit rotation to an additional position. Use the following procedure:

Refer to detail.

(a) Rotate the switch to the F1 position.

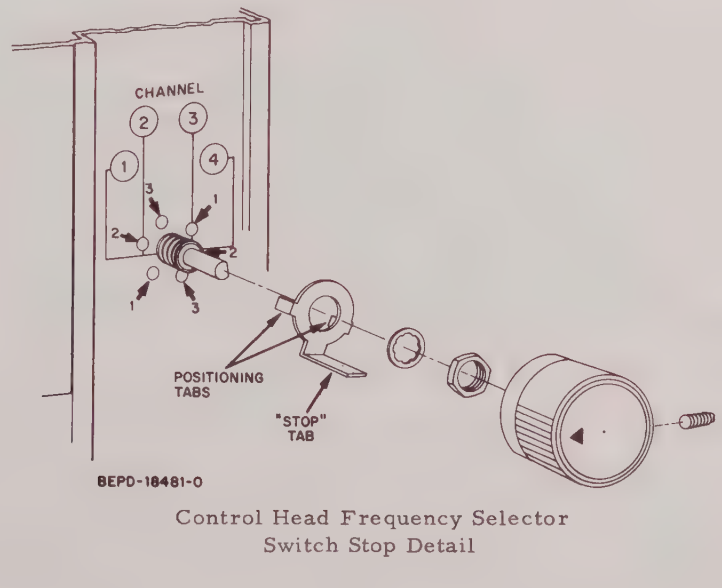
(b) Loosen the set screw and remove the knob.

(c) Unscrew the stop (Motorola Part No. 46B82187H01) and re-install as shown. Remove the stop entirely for four-frequency operation.

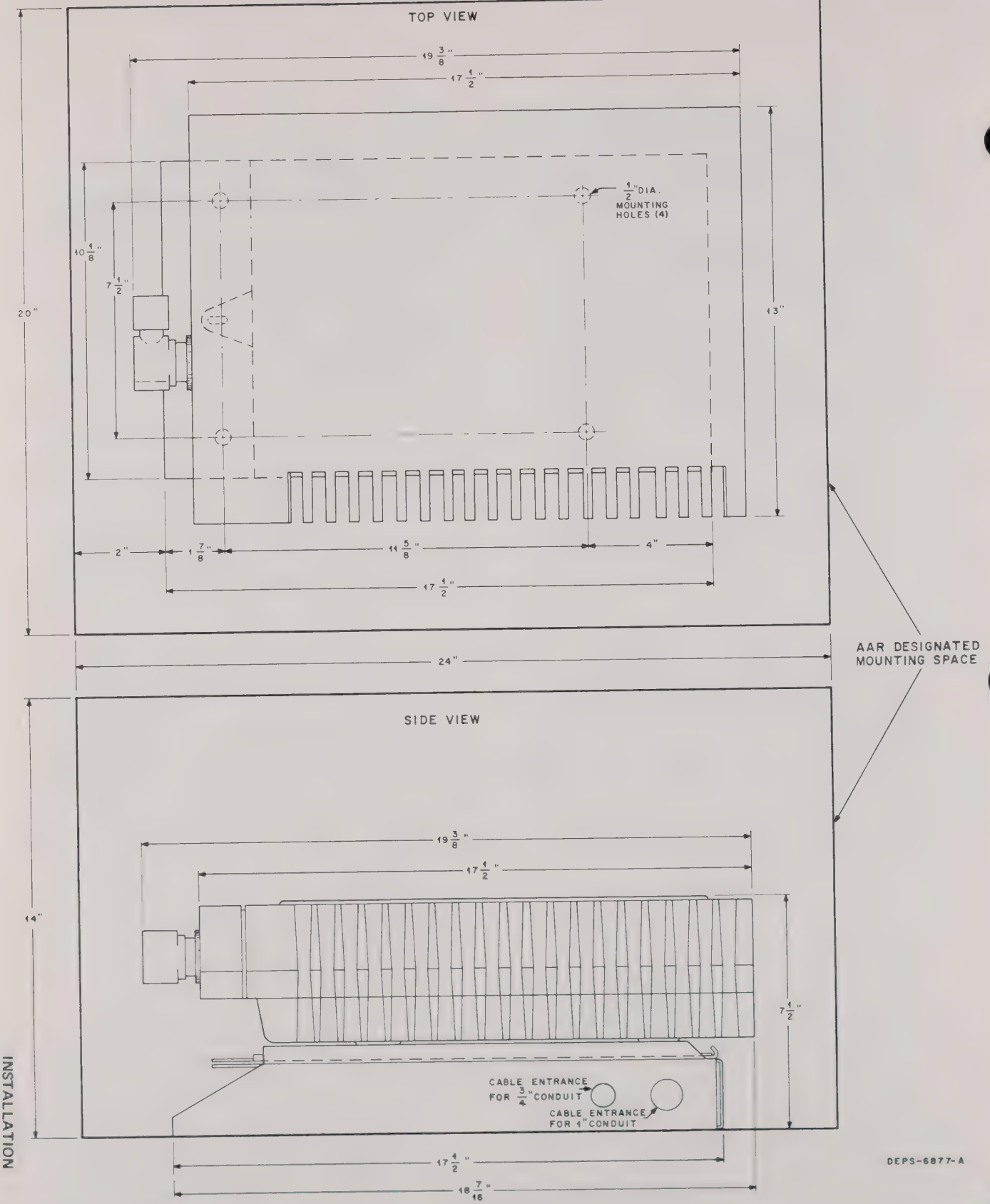
(d) Replace the knob.

(2) Eight-Channel Models

Set the mechanical stop as previously described. The stop should be positioned according to the group having the larger number of frequencies. If possible, arrange the channels into two equal groups.

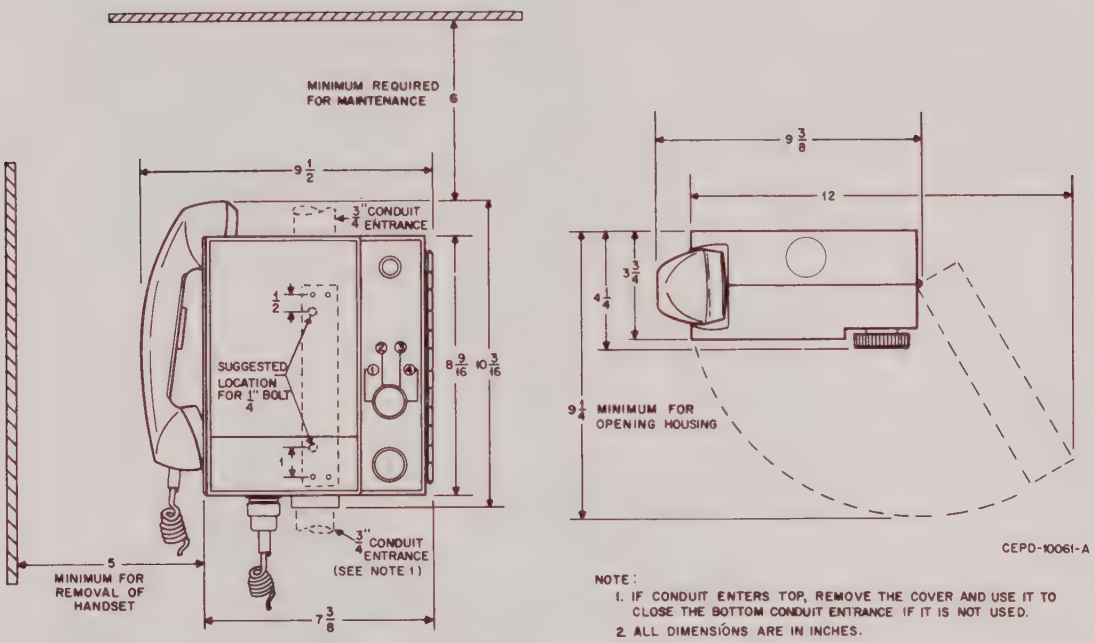


Control Head Frequency Selector Switch Stop Detail



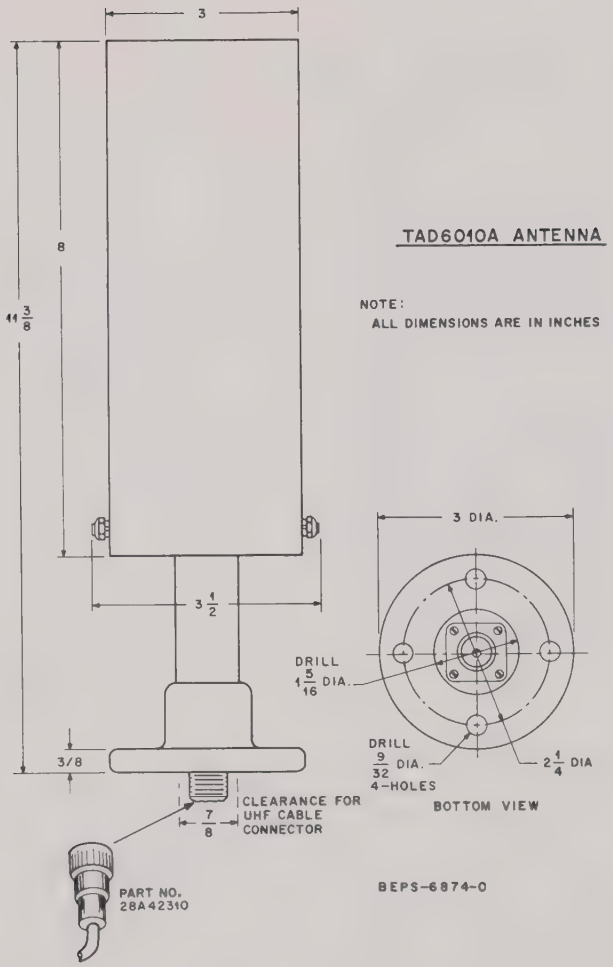
INSTALLATION

Mounting Rack
Dimensional Outline &
Installation Detail
Motorola No. DEPS-6877-A
7/29/74-NPC



NOTE:
1. IF CONDUIT ENTERS TOP, REMOVE THE COVER AND USE IT TO CLOSE THE BOTTOM CONDUIT ENTRANCE IF IT IS NOT USED.
2. ALL DIMENSIONS ARE IN INCHES.

Control Head
Dimensional Outline &
Installation Detail
Motorola No. CEPD-10061-A
7/29/74-NPC



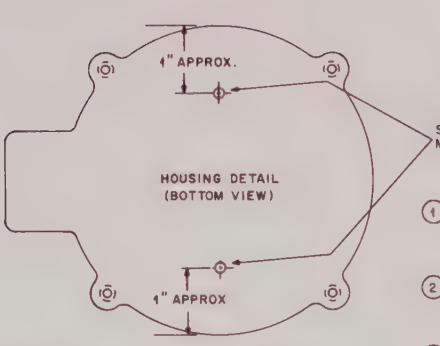
TAD6010A ANTENNA

NOTE:
ALL DIMENSIONS ARE IN INCHES

BEPS-6874-O

INSTALLATION

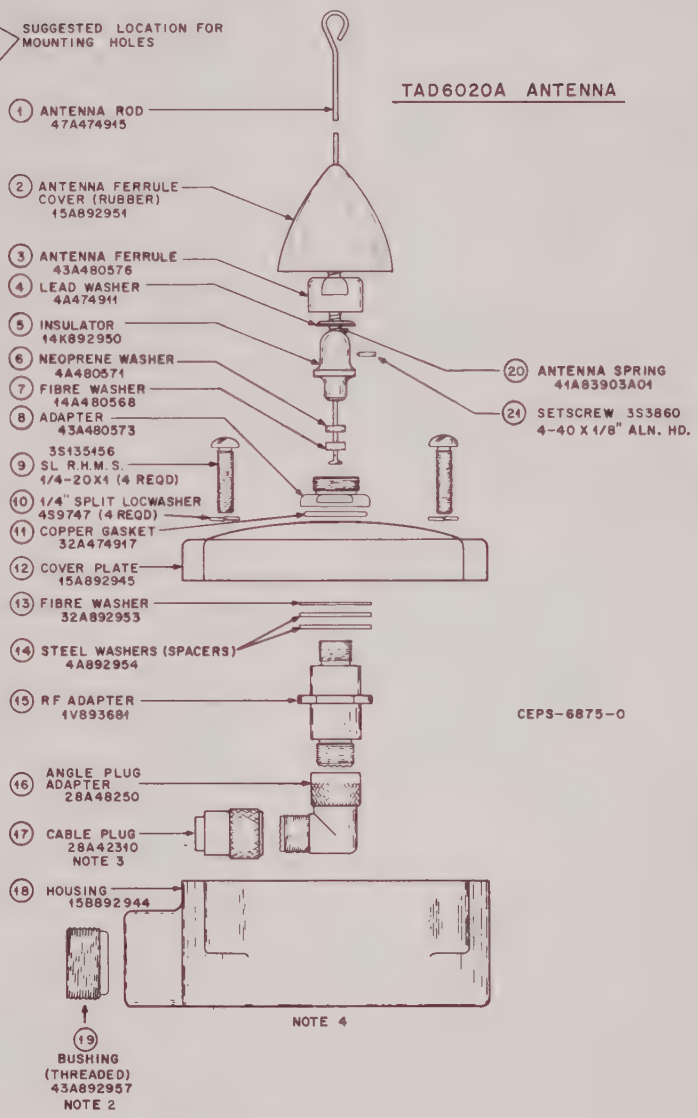
TAD6010A Antenna
Dimensional Outline &
Installation Detail
Motorola No. BEPS-6874-O
7/29/74-NPC



IMPORTANT:
ANTENNA MODEL TAD6020A IS DIRECTLY INTERCHANGEABLE WITH P-8553-E.

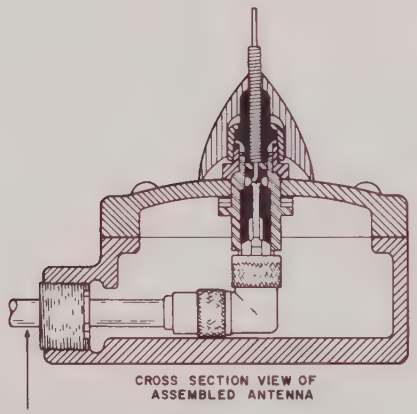
SUGGESTED LOCATION FOR MOUNTING HOLES

TAD6020A ANTENNA



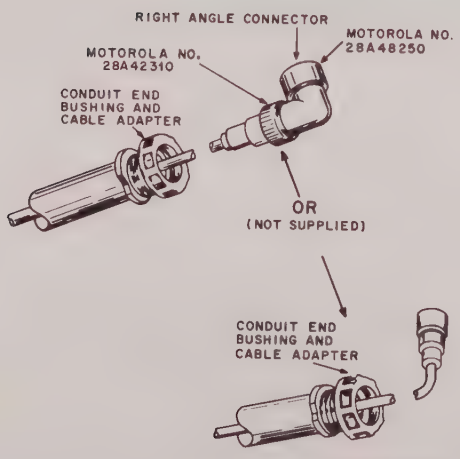
CEPS-6875-O

NOTES:
1. ITEMS 1 TO 7, 20 & 21 CAN BE OBTAINED PRE-ASSEMBLED. (PART NO. 18B893682 ANTENNA ROD ASSEMBLY)
2. HOUSING CONDUIT ENTRANCE IS TAPPED 3/4—14 PIPE THREAD FOR 3/4 I.D. CONDUIT. THE BUSHING (PART NO. 43A892957) REDUCES HOUSING CONDUIT ENTRANCE TO 1/2—14 PIPE THREAD FOR OPTIONAL USE OF 1/2 I.D. CONDUIT.
3. CABLE PLUG (PART NO. 28A42310) NORMALLY SUPPLIED IS FOR USE WITH RG-8/U CABLE. FOR RG-58A/U CABLE, USE THIS PLUG PLUS 58K854020 CABLE ADAPTER. (NOT SUPPLIED WITH ANTENNA)
4. DRILL MOUNTING HOLES IN ANTENNA HOUSING (18) AS REQUIRED. SEE DETAIL.
5. A 34" DIAMETER METAL PLATE MUST BE USED AS A GROUND PLANE UNLESS ANTENNA IS MOUNTED UPON AN EQUIVALENT METAL SURFACE.



CROSS SECTION VIEW OF ASSEMBLED ANTENNA

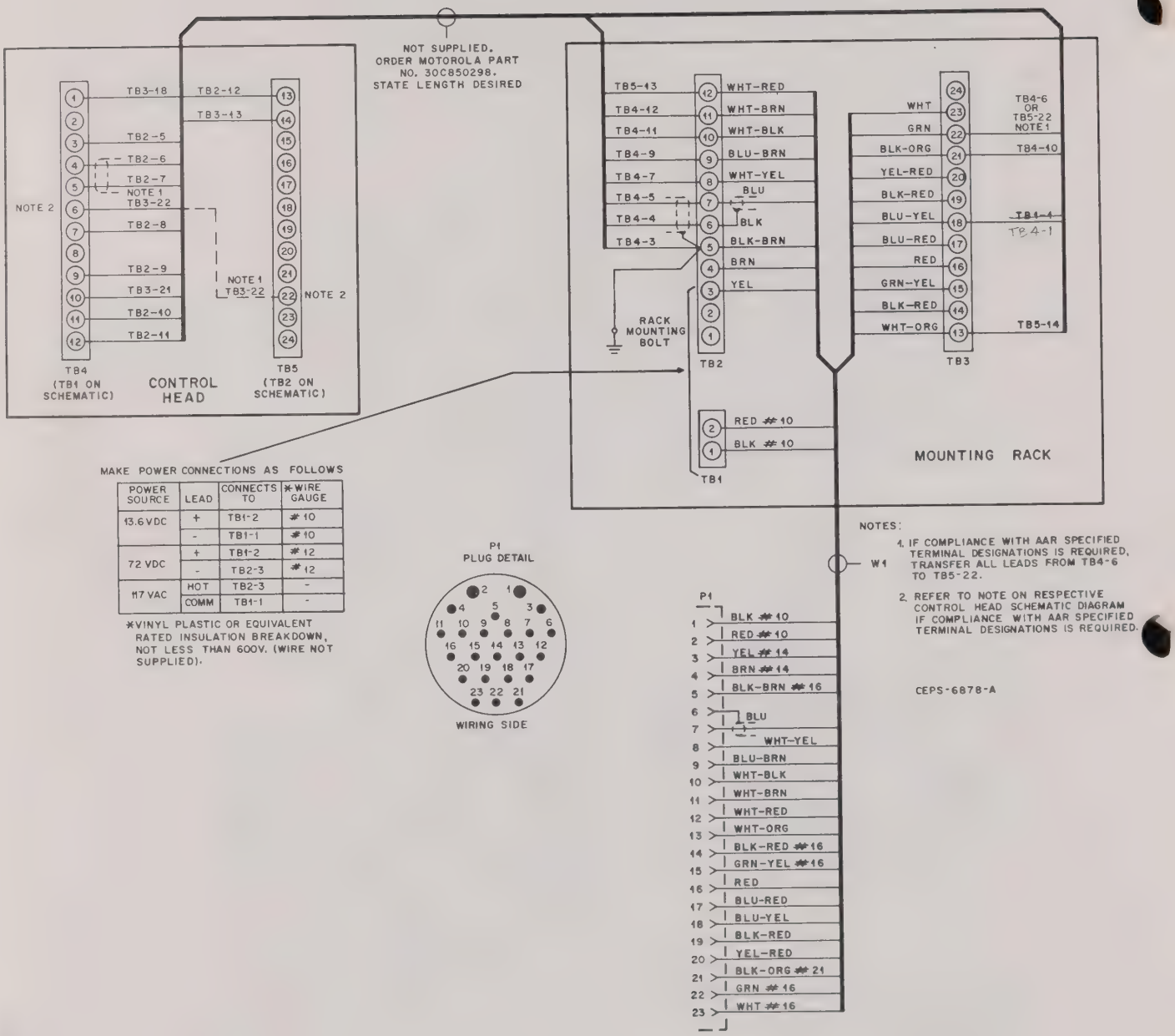
RG-8/U CABLE NOT SUPPLIED



AEPS-6873-O

INSTALLATION

TAD6020A Antenna
Installation Detail
Parts Breakdown
Motorola No. PEPS-7086-O
7/29/74-NPC



INSTALLATION

Mounting Rack and Control Head
Intercabling Diagram
Motorola No. CEPS-6878-A
7/29/74-NPC

1. PRE-OPERATIONAL CHECKS AND ADJUSTMENTS

Before placing the equipment in operation, the following procedures should be performed:

a. General

Check all lugs, cable connections, fuses, and bolted connections.

b. Power

(1) Place the system power switch in the "ON" position.

(2) One of the white channel indicator lamps should light to indicate "power on". On non-reverting models, the lamp must correspond with the position of the frequency selector switch. On channel reverting models, hang up the handset. The lighted lamp indicates the frequency to which the radio set reverts, when the handset is hung up, regardless of the position of the frequency selector switch.

c. Transmitter

(1) Load the transmitter to the antenna as described in the TRANSMITTER ALIGNMENT PROCEDURE.

(2) Check the transmitter for proper operating efficiency by comparing the meter readings as listed on the TRANSMITTER ALIGNMENT PROCEDURE.

d. Receiver

The receiver VOLUME and SQUELCH controls are located on the control board. Locate these controls and adjust as described in the RECEIVER ALIGNMENT PROCEDURE in this manual. On "Private-Line" tone-coded squelch models, set the "PRIVATE-LINE" switch to the OFF position during the adjustment.

2. OPERATING PROCEDURE

a. Turn the Equipment "ON"

Primary power "on-off" facilities must be provided since they are not incorporated in the radio equipment.

b. To Transmit

(1) Remove the handset from the hang-up bracket.

(2) Turn the frequency selector switch to the desired channel. On channel reverting models, also press the PUSH TO CHANGE CHANNEL button to select any channel other than the reverting channel. On eight-channel models, set the group select switch to the desired position.

(3) Note that the channel indicator lamp for the desired channel is lighted.

(4) Monitor the channel to make sure it is not in use. On "Private-Line" tone-coded squelch models, it is necessary to momentarily set the "PRIVATE-LINE" switch to the OFF position to monitor the channel.

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(5) Press the push-to-talk switch on the handset. The blue TRANSMIT indicator lamp glows while the transmitter is keyed.

AEPS-6971-O

Typical AAR Control Head

(6) Speak directly into the mouthpiece of the handset at a normal voice. Motorola transmitters cannot be overmodulated due to the limiting action of the IDC ("Instantaneous Deviation Control"). Release the handset "push-to-talk" button upon completion of the transmission.

(7) If the radio set is equipped with an optional time-out timer, the transmitter shuts off after one minute of continuous operation. This is indicated by an alert tone from the control head speaker. To reset the time-out timer for another minute of transmission, merely release the push-to-talk switch momentarily.

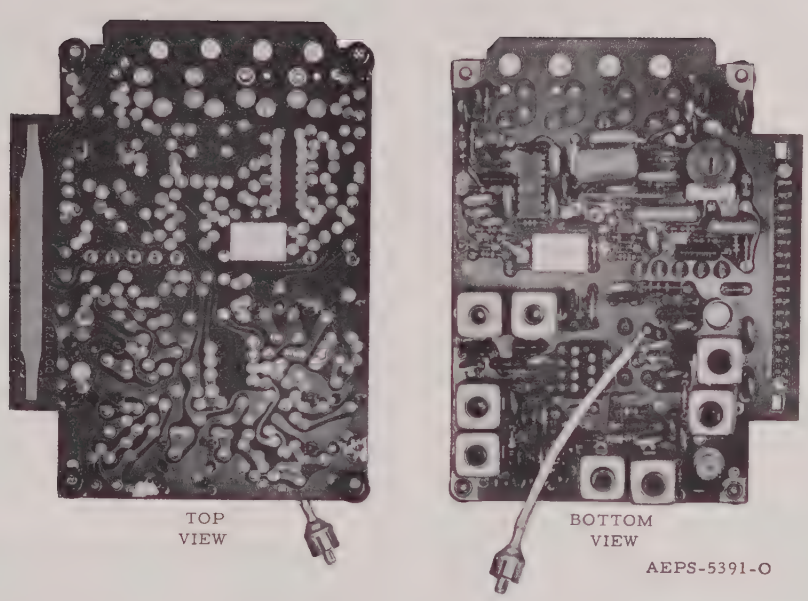
c. To Receive

The receiver operates normally when the "push-to-talk" button is released. When signals are heard, adjust the VOLUME control on the control head for the desired listening level.

On channel reverting models, the receiver operates only on the reverting channel when the handset is hung up. To receive another channel, lift the handset, select the desired channel with the frequency selector switch, and press the PUSH TO CHANGE CHANNEL button.

EXCITER

MODEL TLD5282A
(FORMERLY MODEL TLD1901A)



TOP VIEW

BOTTOM VIEW

AEPS-5391-O

TECHNICAL CHARACTERISTICS

FREQUENCY	150.8-174 MHz
NUMBER OF CHANNELS	1 to 4
MAXIMUM FREQUENCY SEPARATION	±750 kHz
OSCILLATOR FREQUENCY	12.5-14.5 MHz
FREQUENCY MULTIPLICATION	12 times
OUTPUT POWER	400 milliwatts
OUTPUT IMPEDANCE	50 ohms
MODULATION	Phase Modulation
MODULATOR TYPE	Serrasoid
DEVIATION	±5 kHz, adjustable instantaneous deviation limiting.
AUDIO RESPONSE	6 dB/octave pre-emphasis 300 to 3000 Hz
AUDIO SENSITIVITY	165 millivolts for ±3.3 kHz deviation (exciter alone)
AUDIO DISTORTION	Less than 3% at 60% rated deviation @ 1000 Hz
POWER REQUIREMENTS	Regulated +9.6 volts dc @ 150 mA ±13.6 volts dc @ 100 mA
CONSTRUCTION	Fully solid-state, two integrated circuits
METERING	Five test points critical to operation and alignment are accessible at a metering receptacle which permits testing with a Motorola portable test set or 0-50 uA microammeter with 2,000 ohms series resistance.

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MODEL TABLE

MODEL	FORMER MODEL	CONSISTED OF
TLD5282A	TLD1901A	TLD8262B Exciter Board TLN5673A Filter Kit

1. DESCRIPTION

The fully solid-state exciter provides the low power excitation for an FM transmitter. Two integrated circuits, six transistors, and plug-in channel elements are used to develop a phase-modulated carrier signal of at least 400 milliwatts.

The operating frequency and the frequency stability are determined by a plug-in oscillator module (channel element); one such channel element is required for each operating frequency. The exciter accepts up to four channel elements. Audio from a microphone is amplified and clipped to limit maximum deviation to ±5 kHz by an integrated circuit IDC ("Instantaneous Deviation Control") circuit. The phase modulator is contained in another integrated circuit. Frequency multiplication and power amplification are provided by transistor stages. The crystal oscillator frequency is multiplied by 12 to provide the desired carrier frequency output.

The exciter is constructed on a single circuit board which is easily removed and replaced. All external connections are made at a single row of pins which eliminate interconnecting wires, and one coaxial connector for the output. All alignment points are accessible from the shield side of the board. When the exciter is used in "Private-Line" radios, a "Private-Line" encoder circuit board is plugged directly into the mating pins of the exciter; and one jumper is removed from the exciter; no interconnecting wires are used.

2. FUNCTIONAL OPERATION

a. General

Refer to the exciter block diagram, Figure 1. Voice audio from a microphone is applied to the IDC circuit which clips all voice peaks over a certain level to a constant amplitude. The IDC adjustment sets the desired amount of deviation produced by the voice audio. This audio is amplified and applied to the modulator. In "Private-Line" (PL) radios, the PL tone is injected to provide a constant amount of modulation. The channel elements provide a stable, crystal

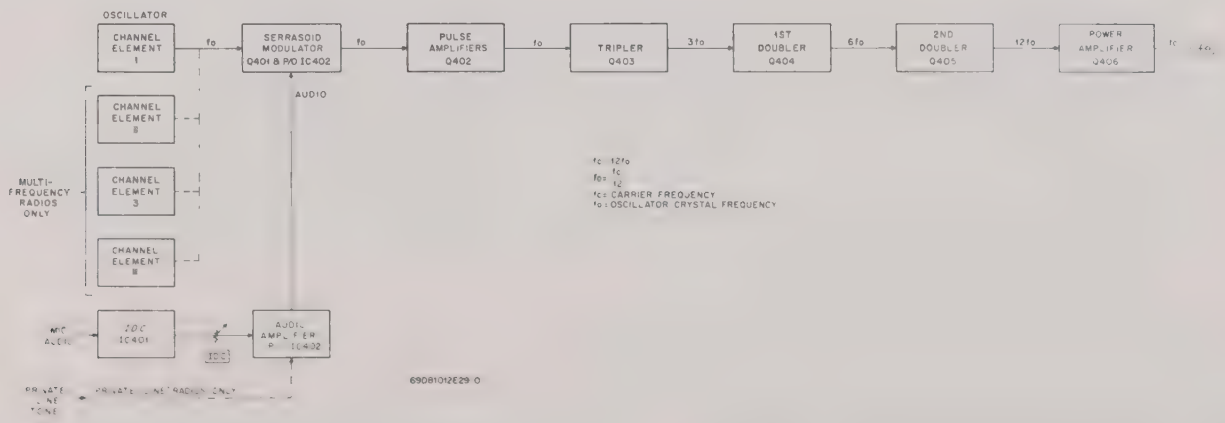

Figure 1.
Exciter Block Diagram

controlled pulse output to the modulator. In the serrasoid modulator, the pulses are converted into sawtooth waves, that are compared to the audio to form a squarewave with the leading edge varying with the audio input. Thus, a phase modulated output signal is developed. The tripler and doubler stages multiply the modulator frequency and deviation 12 times to produce the desired frequency modulated output signal. A power amplifier stage gives at least 400 milliwatts output and matches the impedance to 50 ohms. Each of the stages is described in more detail in the following paragraphs.

b. IDC Circuit

The Motorola IDC circuit processes the microphone audio to prevent over-deviation while giving the modulator the proper audio drive for full deviation over a wide range of audio amplitudes. It does so over the entire 300-3000 Hz voice communications audio range with a very low amount of distortion.

Most of the IDC circuit is encapsulated in thick film integrated circuit IC401, although some important audio frequency response shaping components and the deviation adjustment are external to the integrated circuit. Refer to Figure 2 for a simplified schematic diagram of the entire circuit.

The transistorized microphone requires a dc supply voltage for operation. This voltage is provided by the exciter through a voltage divider network from the keyed +9.6 volt input. The dc voltage to the microphone and the audio signal from the microphone are carried on the same conductor.

The microphone audio is coupled through a pre-emphasis network which couples 300 to 3000 Hz audio signals and provides a 6 dB per octave pre-emphasis characteristic; that is, as frequency doubles the amplitude increases 6 dB. The pre-emphasis network shapes the typical speech signals for more equal amplitude of lows and highs before their application to the clipper amplifier.

In the clipper amplifier portion of integrated circuit IC401, the voice signal is amplified and all voice peaks which exceed a fixed limiting level are clipped. In normal operation, some voice peaks have sufficient amplitude to be clipped. Clipping of the voice peaks will produce undesired harmonics which are greatly attenuated by the splatter filter. The high input impedance amplifier provides additional gain and isolation to the clipped audio signal. The output of the high input impedance amplifier is developed across the IDC potentiometer. This audio signal can be measured at pin 1 of the metering receptacle. The potentiometer adjusts the maximum level of audio coupled to the modulator, thus setting the amount of deviation. The de-emphasis network between the IDC potentiometer and the final audio amplifier provides a 6 dB per octave de-emphasis characteristic which reverts the audio signal to its original response characteristic except when the clipper amplifier is driven into clip. A

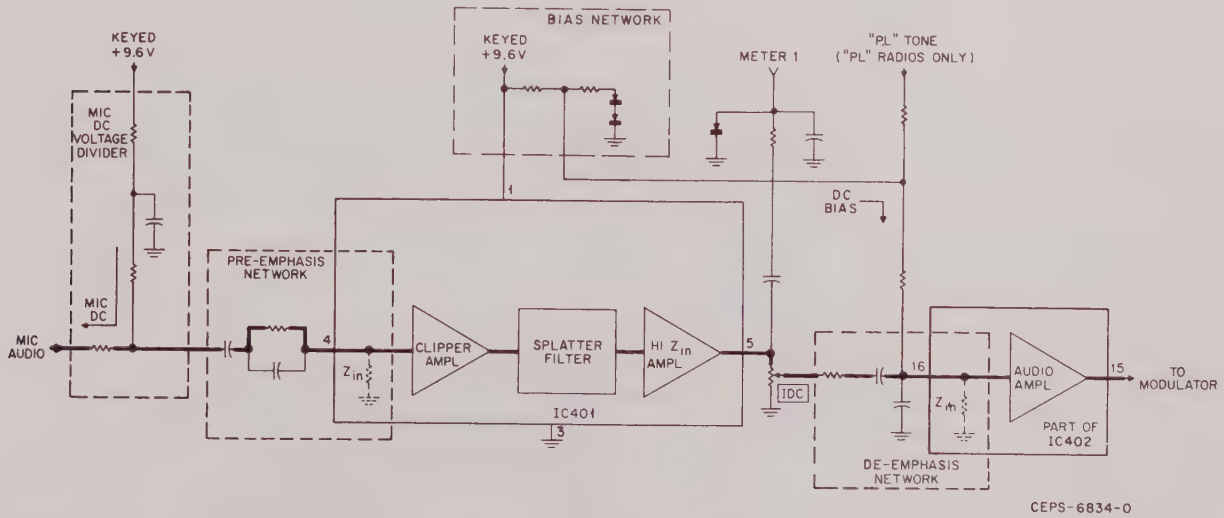

Figure 2.
IDC Circuit Simplified Diagram

final audio amplifier (part of integrated circuit IC402 gives additional gain and isolation before the audio signal is applied to the modulator. A dc bias voltage for the final audio amplifier is developed by the diode-resistor network shown.

In "Private-Line" radios, a low amplitude "Private-Line" tone is continuously injected into the input of the final audio amplifier from the "Private-Line" encoder. This tone, which is a specific frequency in the 67 to 210 Hz range, will produce 0.5 to 1.0 kHz deviation.

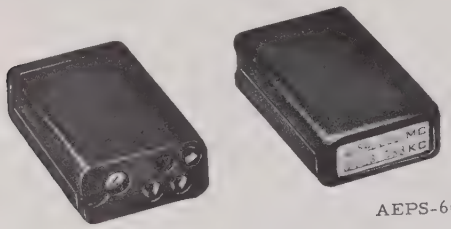

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Figure 3.
Channel Element

c. Oscillator (Channel Element)

Channel elements are highly stable crystal-controlled oscillators. They use unheated crystals in an oscillator circuit that is temperature compensated over the entire temperature range of -30°C to +65°C (-22°F to +149°F). Variable warp capacitors in the base of each channel element are accessible through holes in the exciter circuit board for fine frequency adjustment. Each channel element is a factory sealed, plug-in module which provides a train of stable frequency positive pulses.

The exciter accepts up to four channel elements. One channel element is required for each frequency. An external frequency selector switch completes the dc ground path for the desired oscillator. Only one frequency may be selected at a time, but transmission is possible on as many as four separate frequencies. The channel element output is developed only when the keyed +9.6-volt supply voltage is applied by keying the transmitter or netting the radio. An output indication of the selected channel element is available at pin 2 of the metering socket. This allows channel element operation to be easily checked with a Motorola portable test set.

d. Serrasoid Modulator

The rf output of the channel element is applied to the modulator which shifts the phase of the signal at an audio rate. Most of the modulator circuit is encapsulated in integrated circuit IC402. Refer to the simplified diagram of the circuit (Figure 4). The pulse output from the channel element is capacitively coupled to provide a series

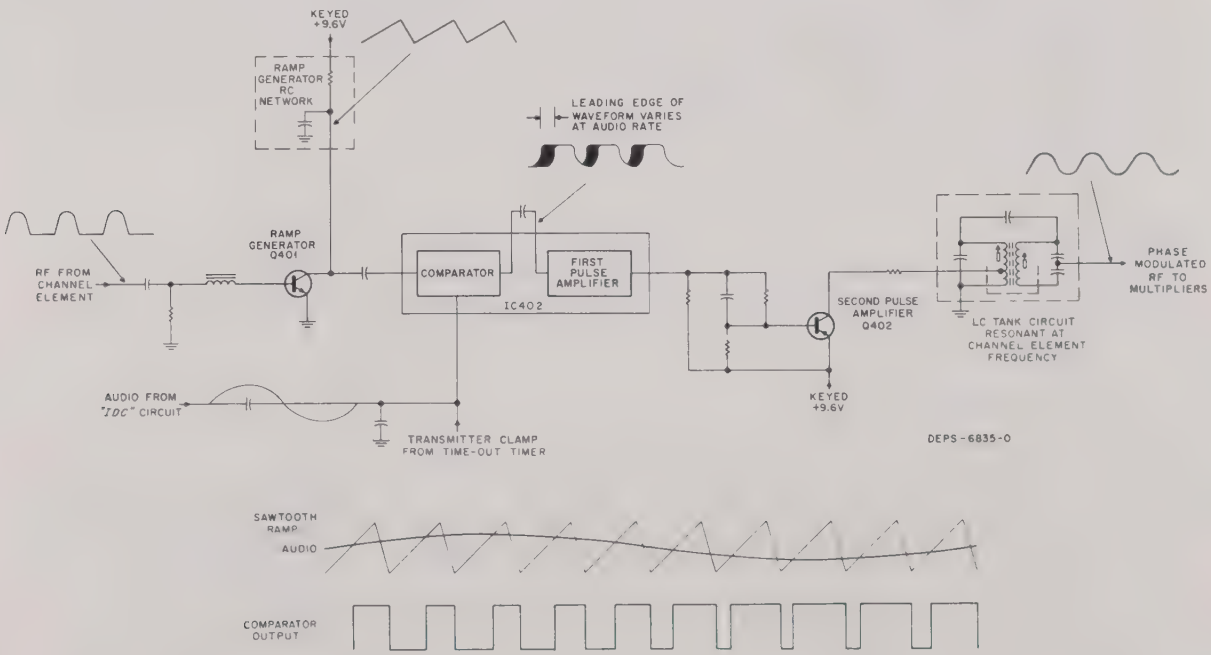


Figure 4.
Simplified Modulator Circuit

of triggers to the ramp generator. Since the pulse is very stable, the time duration between triggers is also constant. The ramp generator produces a positive going sawtooth (ramp) output at the channel element frequency.

Modulation takes place in the comparator. The comparator compares the increasing ramp voltage to the audio signal input and switches when the ramp voltage exceeds the audio voltage. The output of the comparator is a pulse signal whose leading edge varies in starting time at the audio rate. The pulse amplifiers use only the leading edge to feed a parallel tuned tank circuit which is resonant at the channel element frequency. The resonant circuit shapes the signal into a phase modulated sinusoidal waveform.

An external input from a time-out timer (if the radio set is so equipped) clamps the audio input point of the modulator to ground which prevents an rf output from the modulator. Therefore, the entire transmitter is shut down.

e. Multipliers and Power Amplifier

The multipliers develop an output signal that is 12 times the channel element frequency and a power amplifier gives power gain and matches the output impedance to 50 ohms. Refer to Figure 5 and the following explanation for circuit operation.

The second pulse amplifier output is developed across two parallel resonant tank circuits at the channel element frequency. Tripler Q403 operates as a class C amplifier with its parallel resonant output tuned to the third harmonic of its input. Thus the output of the tripler is three times the channel element frequency. A meter connected at pin 3 of the metering receptacle measures the average dc base current which is proportional to input signal strength.

The first doubler circuit operates very similar to the tripler except its output is tuned to the second harmonic of its input and its drive is metered at pin 4. The output

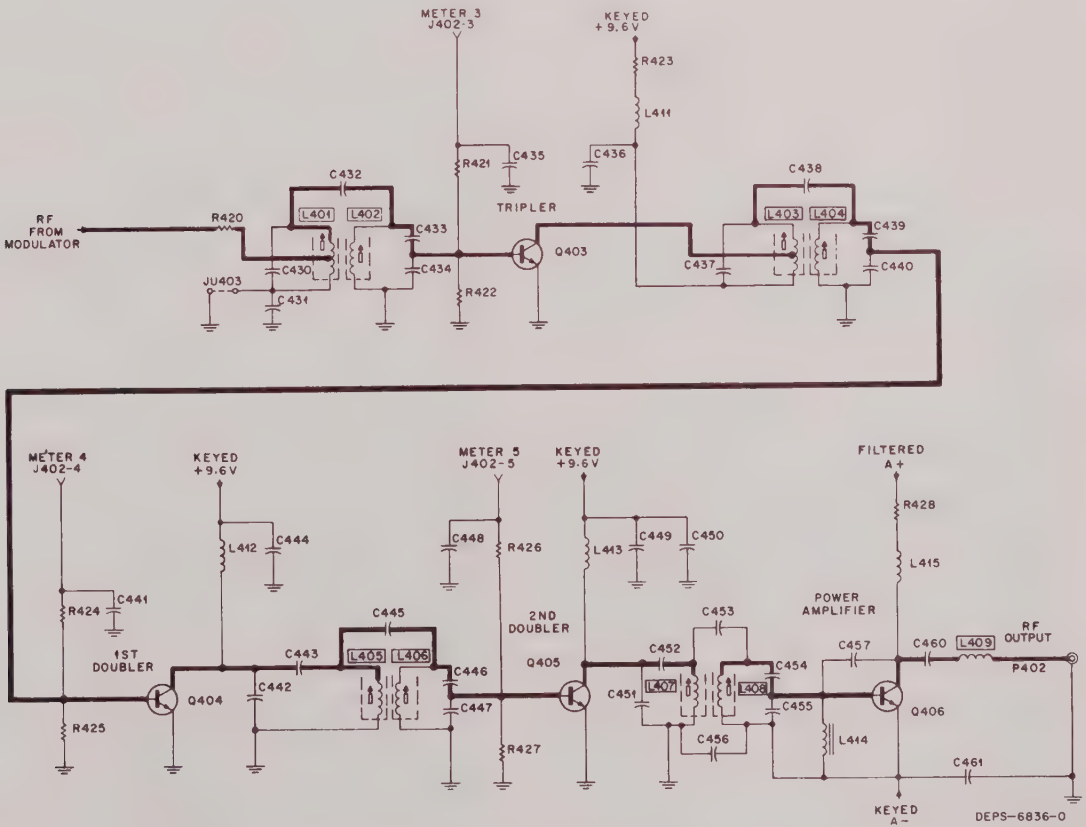


Figure 5.
Multiplier and Power Amplifier Circuit

of the doubler is six times the channel element frequency.

The second doubler circuit also operates similar to the tripler with its output tuned to the second harmonic of its input. The drive to the second doubler is metered on pin 5 of the metering receptacle. The output signal is 12 times the channel element frequency and is the carrier frequency of the transmitter.

The power amplifier also operates as a class C amplifier. The amplifier provides at least 400 milliwatts of frequency modulated signal at the carrier frequency to the power amplifier section of the transmitter.

Power is applied to the tripler and doubler stages only when the transmitter is keyed or netted (keyed +9.6 volts is applied). Filtered A+ is continuously applied to the power amplifier stage while keyed A- is applied only when the radio is keyed. Netting the radio activates the multiplier stages but not the power amplifier stage.

3. MAINTENANCE

CAUTION

Care must be exercised if the radio is to be bench tested by the application of 12-volts directly to the radio transmitter and/or receiver stages. The power supply deck provides overvoltage and surge protection for these circuits; hence, an external power supply feeding the rf circuits directly must be well enough regulated to provide supply voltages that remain below harmful levels. Such a supply must provide a terminal voltage of 13.4 volts under full load with the transmitter keyed, but not exceed 16.5 volts (including transients) when switched to the no load (unkeyed) condition. Most power supplies will not meet this requirement; in fact, some SCR regulated power supplies have transient response that allows the output voltage to momentarily triple when switched from full load to no load. The following bench supplies are approved for testing the "Micor" radio when the power supply deck is bypassed:

Motorola S1303A or S1305A Regulated Power Supply.

Motorola T1261A Transistorized 24-Volt to 12-Volt Converter driven by a Motorola T1012A Power Supply.

12-Volt automotive battery with a Motorola T1012A Power Supply used as a battery charger.

a. General

This section of the manual provides the maintenance shop type procedures for the exciter. It assumes that preliminary tests have already localized the trouble to the exciter. These bench tests include measurements with a Motorola portable test set, and procedures for testing and troubleshooting; including integrated circuit check-out.

NOTE

The exciter must be installed in a radio set for testing to provide the necessary power, ground, control and signal connections. The circuit board should always be secured in place with all mounting screws for operation and testing to provide a good rf ground to all stages of the exciter.

b. Test Set Metering

The exciter is equipped with a metering receptacle which allows five major test points to be measured on a Motorola portable test set. The output of the exciter (input to the power amplifier) can be measured on the portable test set connected to the metering receptacle on the power amplifier. With the portable test set connected to the metering receptacles, readings may be made at each of the major test points in the circuit by merely rotating a selector switch on the test set. A failure in almost any portion of the exciter will produce a low or zero meter reading for one or more of the test points. Improper alignment will also cause improper meter readings.

To make the measurements, the portable test set must be connected to the radio set as shown in Figure 6 and listed in the following procedure.

(1) Connect the 20-pin plug of the adapter cable to the test set. When the test set is not in use, disconnect the 20-pin plug to conserve battery life. The plug acts as an on-off switch completing the battery circuit.

(2) Connect the red "control" plug of the adapter cable to the receptacle on the circuit board of the radio set control board. Connect the white "metering" plug of the adapter cable to the metering receptacle on the exciter circuit board.

(3) Set the function selector switch of the portable test set to the XMTR position.

(4) Set the oscillator and meter reversing switch of the test set to the OFF position.

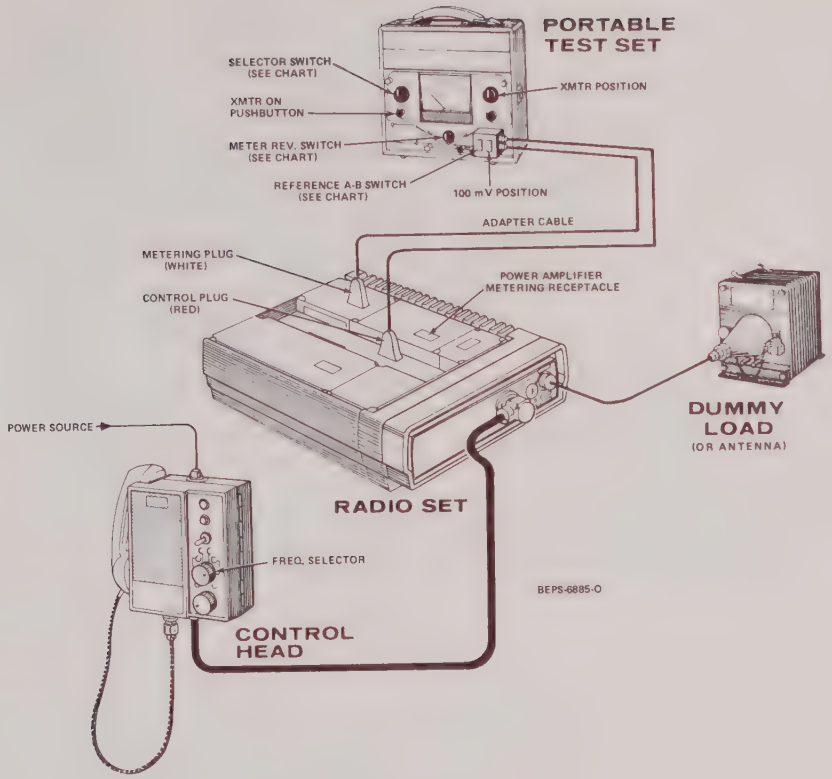


Figure 6.
Exciter Metering Test Set-Up

(5) Set the 1 V-100 mV switch on the adapter cable to the 100 mV position (TEK-37). On the later version adapter cable (TEK-37A), the switch is omitted and the unit operates at 100 mV sensitivity.

(6) Set the REF A-B switch on the adapter cable to position A.

(7) The output of the exciter must be terminated into its normal point, the banspass filter. The output of the power amplifier must be terminated in a 50-ohm dummy load or an antenna.

(8) Connect power to the radio set.

(9) Set the selector switch of the test set to position 1. Using the push-to-talk switch on the handset, key the transmitter and whistle into the handset long enough to observe the meter reading.

(10) Set the selector switch to positions 2, 3, 4, and 5 respectively, keying the transmitter with the XMTR ON pushbutton on the test set or the push-to-talk switch on the handset and observing the meter reading for each position. On multi-frequency radio sets, repeat the readings for each exciter frequency. An analysis of the meter readings for determining whether each circuit is good or bad follows step (13).

(11) Move the "metering" plug to the power amplifier metering receptacle and observe the meter reading for selector switch position 1. The reference A-B switch must be set to the B position and the meter reversing switch to METER REV.

Each time maintenance is performed on the exciter, the readings should be compared with the previous set of readings. Any degradation of performance will quickly be noted. Often, a lower reading may indicate an impending failure and corrective action may be taken before the circuit fails entirely. The minimum values given in the table may be used if no previous readings are available. However, these readings are an absolute minimum for normal operation and are no substitute for a log of meter readings. A typical exciter may have much higher readings and should not be allowed to drop to these minimum values before corrective action is taken. If a log is maintained, even a small drop in meter readings will be noticed. This condition should be interpreted as abnormal operation and corrective action taken (such as realignment) to assure continued peak performance.

MINIMUM EXCITER METER READINGS

SELECTOR SWITCH POSITION	REFERENCE SWITCH POSITION	READING	CIRCUIT METERED	IF LOW, THE DEFECTIVE CIRCUIT IS
1	A	12 (NOTE 1)	Audio output of IDC circuit.	IDC circuit
2	A	10	Channel element output.	Channel element
3	A	15	Tripler input	Modulator or tripler
4	A	20	1st doubler input	Tripler or 1st doubler
5	A	15	2nd doubler input	1st doubler or 2nd doubler
1 (NOTE 2)	A	20 (NOTE 3)	Exciter output	Exciter power amplifier

NOTES:

1. AUDIO INPUT OF 3 VOLTS @ 1 kHz (MIC SENSITIVITY JUMPERS SET FOR 0.36 V @ 3.5 kHz.)
2. METERING PLUG CONNECTED TO RF POWER AMPLIFIER.
3. POWER AMPLIFIER OPERATING NORMALLY.

c. Performance Tests

The performance tests may be used for troubleshooting to isolate the point of abnormal performance. They may also be used after repair and alignment to assure that the exciter meets all specifications before it is returned to service.

(1) Power Output Test

(a) Specifications

1. The exciter shall provide at least 400 milliwatts rf output on the assigned frequency with input source voltages from 12.0 to 15.5 volts dc.

2. On multi-frequency units with frequency separation of less than ±750 kHz, at least 400 milliwatts output shall be provided on each channel.

(b) Procedure (Refer to Figure 6)

1. Connect the equipment as shown in Figure 6 for test set metering except connect the "metering" plug to the power amplifier metering receptacle.

2. Set the selector switch to position 1. This checks the input to the power amplifier (output of the exciter). A meter reading of at least 25 uA equals an rf signal level of 400 milliwatts.

3. On multi-frequency units, repeat the test for each exciter frequency. Select the frequency to be tested by the frequency selector switch on the control head. The test set meter should indicate at least 25 uA for each frequency.

(2) Frequency Test

(a) Specifications

The carrier frequency output of the exciter shall be within .0005% of the assigned frequency for each channel of operation. When high stability channel elements are used, within .0002%.

(b) Procedure (Refer to Figure 7)

1. Connect the equipment as shown in Figure 7 except DO NOT CONNECT THE AUDIO OSCILLATOR TO THE PORTABLE TEST SET. Terminate the transmitter in an antenna and measure the radiated signal with a Motorola Digital Frequency Meter and Deviation Monitor or other highly accurate frequency measuring device (±.0005% or better).

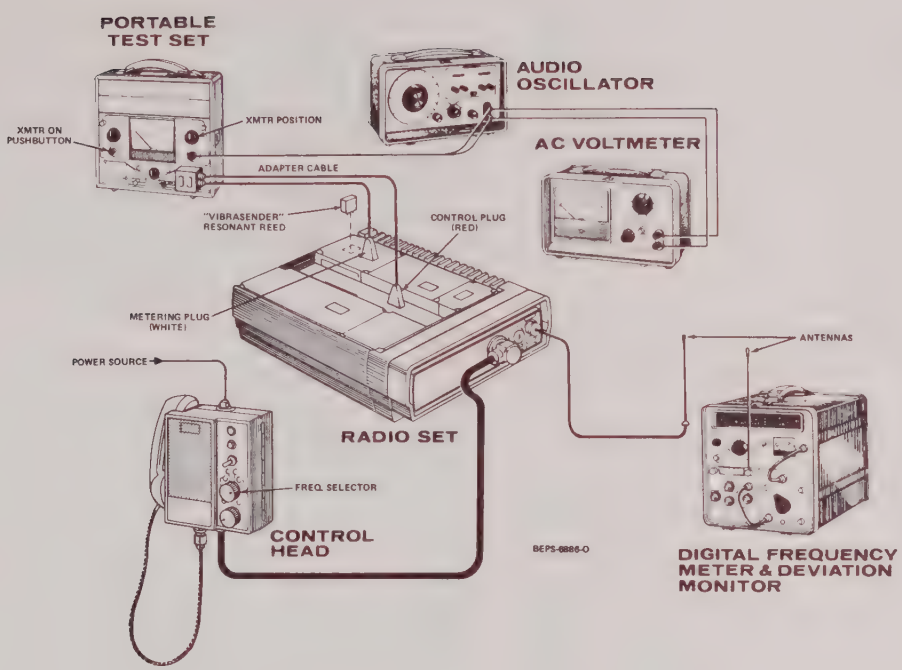


Figure 7.
Frequency, Deviation and Audio Sensitivity Test

2. Key the transmitter to produce an unmodulated carrier signal by using the XMTR ON pushbutton on the portable test set. In "Private-Line" radios, disable the "Private-Line" encoder by unplugging the "Vibrasender" resonant reed.

NOTE

Do not use the push-to-talk switch on the handset. Background noise will modulate the signal.

3. Read the transmitter output frequency. On multi-frequency units repeat the test for each frequency.

4. If adjustment is required, set the "warp" capacitor on the associated channel element for the assigned frequency output. For best accuracy, the radio set should be brought to room temperature (+70° to 75°F) and the test equipment thoroughly warmed up. This brings the channel element to the center of its temperature compensation range. Once calibrated at this temperature, it can most accurately compensate for future temperature changes.

(3) Deviation Test

(a) Specification

1. The exciter output shall deviate ±5 kHz with audio input of 3 volts @ 1000 Hz.

2. In "Private-Line" radios, the exciter output shall deviate 0.5 to 1 kHz with "Private-Line" tone modulation applied.

(b) Procedure (Refer to Figure 7)

1. Connect the equipment as shown in Figure 7. Terminate the transmitter output in an antenna and measure the radiated signal with a deviation meter.

2. In "Private-Line" radios, reinsert the "Vibrasender" resonant reed if it was removed in the previous test. Key the transmitter with only "Private-Line" tone modulation. The deviation meter should indicate 0.5 to 1 kHz.

3. Connect the audio oscillator output to the microphone receptacle on the portable

test set. Adjust the audio oscillator to 1000 Hz and 3 volts as measured on the ac voltmeter. The deviation meter should indicate ±5 kHz deviation.

4. Adjust the audio oscillator over the entire 300 to 3000 Hz range, keeping the audio level at approximately 3 volts. The deviation meter should never exceed ±5 kHz nor drop below ±2.5 kHz.

(4) Audio Sensitivity Test

(a) Specification

An audio input of 360 millivolts at 1000 Hz shall produce approximately ±3.3 kHz deviation.

(b) Procedure (Refer to Figure 7)

1. Connect the equipment as shown in Figure 7. After completion of the Deviation Test, reduce the output of the audio oscillator to 360 millivolts at 1000 Hz.

2. The deviation meter should indicate approximately ±3.3 kHz. Meter position 1 may be noted at this time for future reference. Future audio sensitivity checks may then be made by comparing the meter 1 reading with the reference value.

d. Troubleshooting

(1) Check Input Voltages

If there are no test set indications at one or more of the metered points, check the dc input voltages to the exciter circuit board. Key and unkey the transmitter to see if the voltages are switched.

P902-13	Keyed +9.6 volts in respect to chassis.
P902-6	Keyed A- (approximately -13.6 volts in respect to filtered A+, pin 7).
P902-7	Filtered A+ (approximately +13.6 volts in respect to A-, pin 9).

If test set indications localize the trouble to a specific stage or two, measure the dc input voltages to the suspected stages. Refer to the schematic diagram for the normal voltages.

NOTE

In "Private-Line" radios, the transmitter cannot be keyed if the PL encoder is removed unless a jumper is connected from pin 8 to pin 10 of the exciter to complete the keying circuit. The jumper is permanently connected in exciters for non-"Private-Line" operation.

(2) Alignment as a Troubleshooting Technique

Low test set readings, low power output, and subnormal performance are very often corrected by realignment. Therefore, alignment should be the first troubleshooting step performed for these symptoms. Many technicians prefer to use alignment as the first troubleshooting step in all cases. During the alignment procedure, any trouble caused by a defective component will be discovered and corrected before alignment can be completed.

(3) Isolating Defective Components

If test set readings are abnormal or tests indicate subnormal performance, a logical troubleshooting procedure is required to isolate the defective component efficiently. The test set readings and results of performance tests usually localize the malfunction to one or two specific stages. A zero meter reading indicates either (1) no drive from the preceding stages, or (2) a defective component in the metering circuit which includes the base-emitter junction of the following transistor which operates as a rectifier. The accompanying troubleshooting chart summarizes these results in a logical sequence. A few waveforms, voltage and resistance checks in the suspected circuit should readily isolate the defective component. Note that the final amplifier stage of the exciter is powered by A+ and keyed A- and voltages should be checked in respect to keyed A- instead of chassis ground.

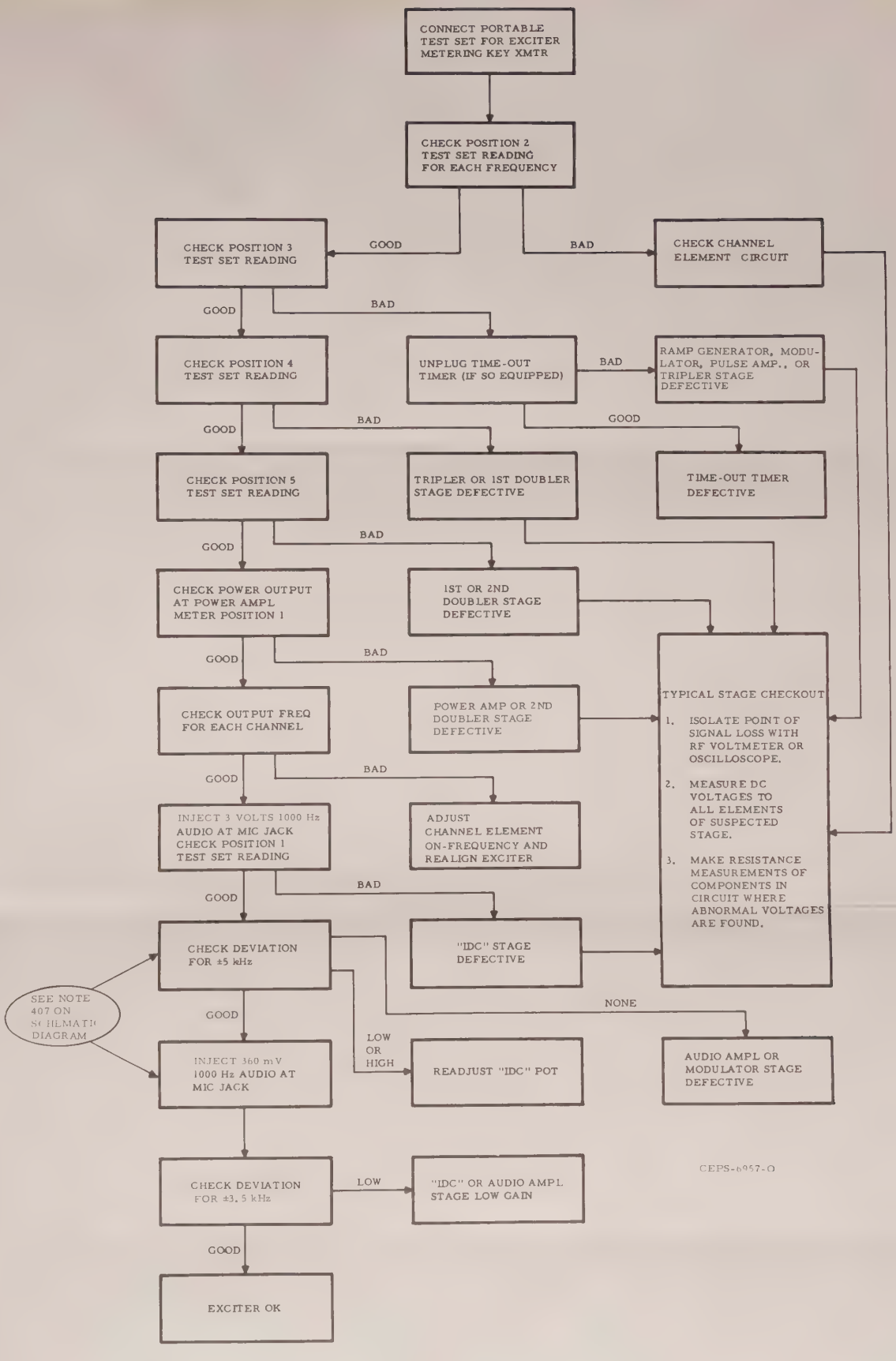
(4) Troubleshooting Integrated Circuits

Integrated circuits (C's) are very reliable components and should not be replaced until all checks have proven definitely that the IC is the defective component. Removal of an IC is time consuming and often ruins the part. Therefore, a few extra checks before that task is attempted are worthwhile. Before replacing a bad IC, make sure that the external components in the circuit are normal.

The IC's in the exciter may be checked by dc voltage measurements although signal tracing with an oscilloscope is preferred. Typical dc voltages and waveforms are shown on the schematic diagram. Modulator waveforms at IC402 are 12.5 to 14.5 MHz and a good rf oscilloscope is required for observing them.

If an IC is to be replaced, heat each IC terminal and remove all solder with a "solder sucker" vacuum bulb or use a special IC removing tool.

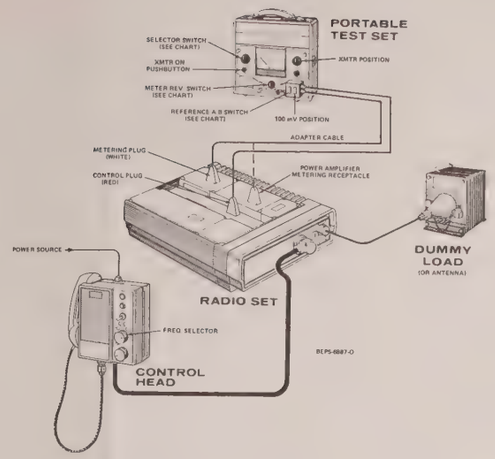
EXCITER TROUBLESHOOTING CHART

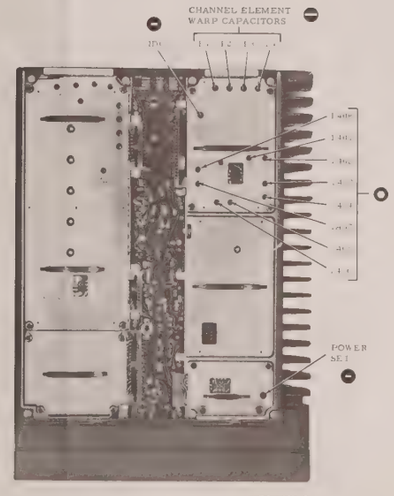


CEPS-6957-O

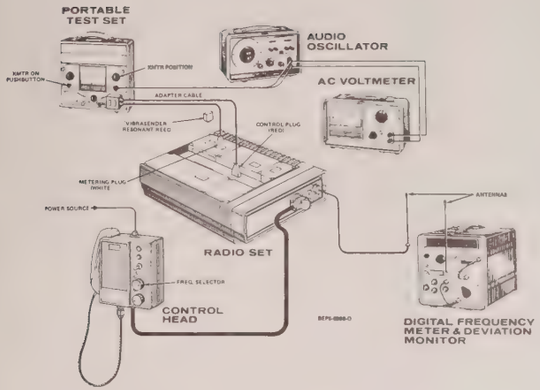
ALIGNMENT PROCEDURE

STEP	ADJUST	METERING PLUG LOCATION	SELECTOR SWITCH POSITION	OSC & METER REV SWITCH POSITION	STAGE AND PROCEDURE
1					SET UP - Connect the test equipment and set switches as shown. Key the transmitter with the XMTR ON pushbutton on the portable test set.
2	POWER SET				OUTPUT - Turn the POWER SET control fully counter-clockwise.
3	FREQUENCY SWITCH	EXCITER	2	OFF REF A	CHANNEL ELEMENT - Select the desired frequency. Key the transmitter. The test set meter 2 should indicate at least 10 uA.
4	ALL EXCITER COILS	EXCITER	3	OFF REF A	PRE-ALIGNMENT - If the exciter is completely untuned and shows no meter 3 reading, set cores of all tuning coils to the top of their coil forms (away from circuit board) and proceed with step 5. If the exciter shows meter 3 readings, set cores of all tuning coils except L401 and L402 to the top of their coil forms (away from the circuit board). Tune L401 and L402 in that order for maximum meter indication. Go to step 7 of the procedure.
5	L401	EXCITER	2	OFF REF A	MODULATOR OUTPUT - Tune L401 for minimum meter reading.
6	L401, L402	EXCITER	3	OFF REF A	MODULATOR OUTPUT - Tune L402, then L401 for peak meter reading.
7	L403	EXCITER	3	OFF REF A	TRIPLER OUTPUT - Tune L403 for minimum meter reading.
8	L403, L404	EXCITER	4	OFF REF A	TRIPLER OUTPUT - Tune L404 and then L403 for peak meter reading.
9	L405	EXCITER	4	OFF REF A	FIRST DOUBLER OUTPUT - Tune L405 for minimum meter reading.
10	L405, L406	EXCITER	5	OFF REF A	FIRST DOUBLER OUTPUT - Tune L406 and then L405 for peak meter reading.
11	L407	EXCITER	5	OFF REF A	EXCITER OUTPUT - Tune L407 for minimum meter reading.
12	L407, L408	PA	1	METER REV REF A	EXCITER OUTPUT - Move the metering plug to the PA. Tune L408 and then L407 for peak meter reading.
13					Repeat steps 6, 8, and 10
14					Align the power amplifier





AEPS-6888-O



OSCILLATOR FREQUENCY ADJUSTMENT

1. Set up the test equipment as shown for frequency measurement. Disconnect the audio oscillator from the portable test set.
2. Key the transmitter with no modulation. Key the transmitter with the XMTR ON pushbutton on the portable test set rather than with the handset. On "Private-Line" radios, unplug the "Vibrasender" resonant reed from the PL tone generator.
3. Adjust the channel element warp capacitor for the selected channel to the exact desired frequency. Adjust the warp capacitor which corresponds to the frequency selector switch setting on the control head; repeat for each frequency.

"IDC" ADJUSTMENT PROCEDURES

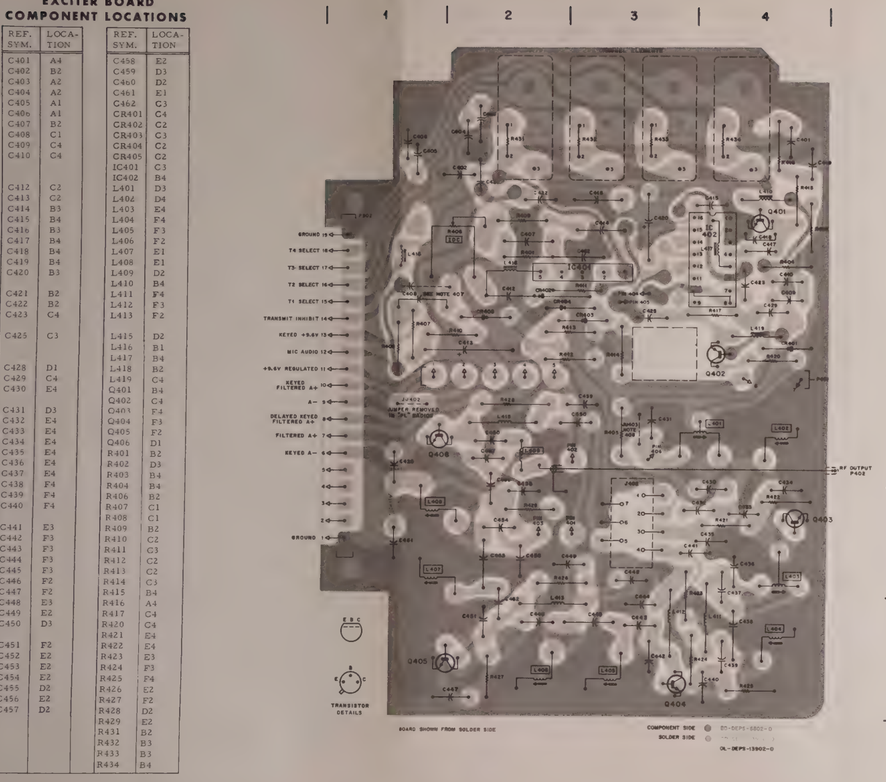
1. Set up the test equipment as shown for deviation measurement. Connect the audio oscillator to the portable test set.
2. Set the audio oscillator to 1000 Hz and 3 volts. On "Private-Line" models, replace the "Vibrasender" resonant reed.
3. Key the transmitter and adjust the IDC control for ±5 kHz deviation.
4. Reduce the tone oscillator output to 0.45 volts. Essentially full deviation should still be indicated. Less than full deviation may indicate a weak audio stage.

EXCITER BOARD COMPONENT LOCATIONS

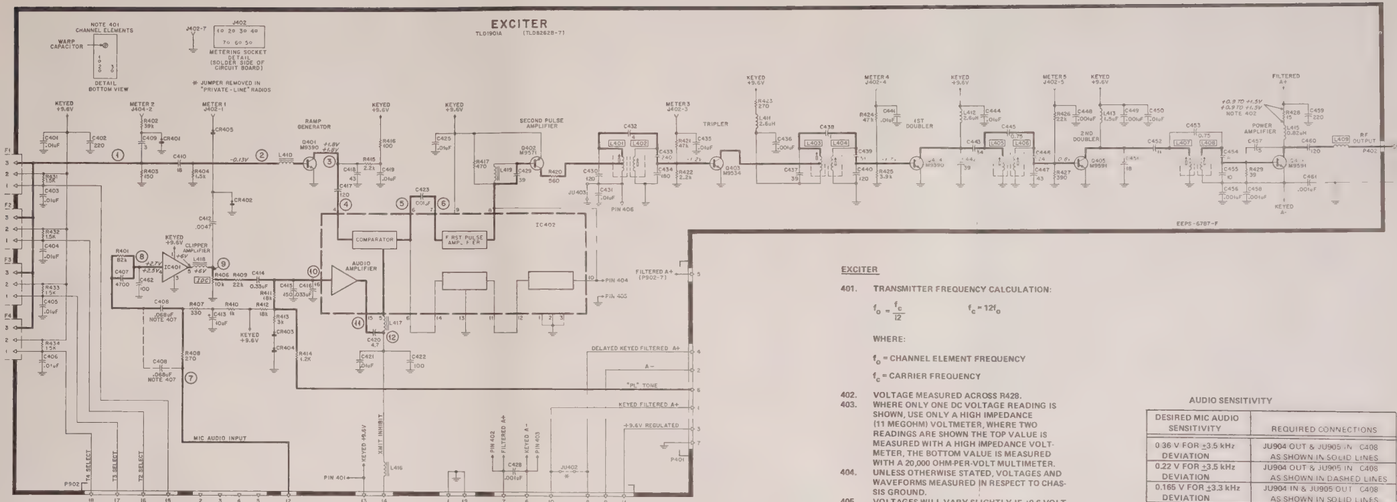
REF. SYM.	LOCATION
C401	A4
C402	B2
C403	A2
C404	A2
C405	A1
C406	A1
C407	B2
C408	C1
C409	C4
C410	C4
C412	C2
C413	C2
C414	B3
C415	B4
C416	B3
C417	B4
C418	B4
C419	B4
C420	B3
C421	B2
C422	B2
C423	C4
C425	C3
C428	D1
C429	C4
C430	E4
C431	D3
C432	E4
C433	E4
C434	E4
C435	E4
C436	E4
C437	E4
C438	F4
C439	F4
C440	F4
C441	E3
C442	F3
C443	F3
C444	F3
C445	F3
C446	F2
C447	F2
C448	E3
C449	E2
C450	D3
C451	F2
C452	E2
C453	E2
C454	E2
C455	D2
C456	E2
C457	D2

REF. SYM.	LOCATION
C458	E2
C459	D3
C460	D2
C461	E1
C462	G3
CR401	C4
CR402	C2
CR403	C3
CR404	C2
CR405	G2
IC401	C3
IC402	B4
L401	D3
L402	D4
L403	E4
L404	F4
L405	F3
L406	F2
L407	E1
L408	E1
L409	D2
L410	B4
L411	F4
L412	F3
L413	F2
L415	D2
L416	B1
L417	B4
L418	B2
L419	C4
Q401	B4
Q402	C4
Q403	F4
Q404	F3
Q405	F2
Q406	D1
R401	B2
R402	D3
R403	B4
R404	B4
R406	B2
R407	C1
R408	C1
R409	B2
R410	C2
R411	C3
R412	C2
R413	G2
R414	C3
R415	B4
R416	A4
R417	C4
R420	C4
R421	E4
R422	E4
R423	E3
R424	F3
R425	F4
R426	E2
R427	F2
R428	D2
R429	E2
R431	B2
R432	B3
R433	B3
R434	B4

EPS-6890-B



EXCITER



EXCITER

401. TRANSMITTER FREQUENCY CALCULATION:

$f_o = \frac{f_c}{12} \qquad f_c = 12f_o$

WHERE:

f_o = CHANNEL ELEMENT FREQUENCY

f_c = CARRIER FREQUENCY

402. VOLTAGE MEASURED ACROSS R428.
403. WHERE ONLY ONE DC VOLTAGE READING IS SHOWN, USE ONLY A HIGH IMPEDANCE (11 MEGOHM) VOLTMETER, WHERE TWO READINGS ARE SHOWN THE TOP VALUE IS MEASURED WITH A HIGH IMPEDANCE VOLTMETER, THE BOTTOM VALUE IS MEASURED WITH A 20,000 OHM-PER-VOLT MULTIMETER.
404. UNLESS OTHERWISE STATED, VOLTAGES AND WAVEFORMS MEASURED IN RESPECT TO CHASSIS GROUND.
405. VOLTAGES WILL VARY SLIGHTLY IF +9.6 VOLT SOURCE IS ABOVE OR BELOW NOMINAL VALUE. NORMAL VARIATION FROM RADIO TO RADIO IS 9.1 TO 10.1 VOLTS REGULATED.
406. UNLESS OTHERWISE STATED: CAPACITOR VALUES ARE IN PICOFARADS.
407. SEE AUDIO SENSITIVITY TABLE.

EPS-6780-O

AUDIO SENSITIVITY

DESIRED MIC AUDIO SENSITIVITY	REQUIRED CONNECTIONS
0.36 V FOR ±3.5 kHz DEVIATION	JU904 OUT & JU905 IN C408 AS SHOWN IN SOLID LINES
0.22 V FOR ±3.5 kHz DEVIATION	JU904 OUT & JU905 IN C408 AS SHOWN IN DASHED LINES
0.165 V FOR ±3.3 kHz DEVIATION	JU904 IN & JU905 OUT C408 AS SHOWN IN SOLID LINES
0.100 V FOR ±3.3 kHz DEVIATION	JU904 IN & JU905 OUT C408 AS SHOWN IN DASHED LINES

EPS-7100-O

ALL RF WAVEFORMS TAKEN UNDER FOLLOWING CONDITIONS:

1. TO OBTAIN WAVEFORMS SIMILAR TO THOSE SHOWN, OSCILLOSCOPE MUST HAVE AT LEAST 50 MHz BANDWIDTH, 7 nanosec RISE TIME AMPLIFIER.
2. VERTICAL SENSITIVITY SHOWN UNDER EACH WAVEFORM.
3. VERTICAL INPUT = DC.
4. HORIZONTAL DEFLECTION = 10 nanosec/DIV.
5. TRANSMITTER KEYED.
6. NO MODULATION (REMOVE "VIBRASENDER" REED" REED IN "PL" RADIO).

EPS-6778-O

EXCITER RF WAVEFORMS (12.5-14.5 MHz)

ALL AUDIO WAVEFORMS TAKEN UNDER FOLLOWING CONDITIONS:

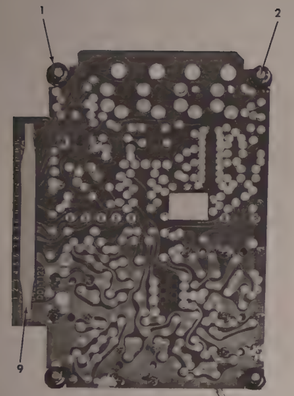
1. VERTICAL SENSITIVITY SHOWN UNDER EACH WAVEFORM.
2. VERTICAL INPUT = AC.
3. HORIZONTAL DEFLECTION = 0.2 msec/DIV.
4. 1000 Hz 1 VOLT rms (2.8 V P-P) AUDIO AT MICROPHONE INPUT.
5. "IDC" POT SET FOR ±5 kHz DEVIATION.

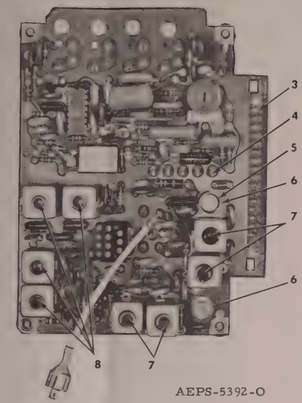
EPS-6779-O

EXCITER AUDIO WAVEFORMS

PREVIOUS REVISIONS AND PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

Model TLD8262B-7 Exciter Schematic Diagram and Circuit Board Detail
Motorola No. 63P81012E11-E
7/29/74-NPC





AEPS-5392-O

MECHANICAL PARTS LIST

IMPORTANT

USE ONLY THE FOLLOWING MOTOROLA PART NUMBERS WHEN ORDERING REPLACEMENT PARTS

TLD8262B Exciter Parts (P/O TLD1901A) PL-2665-O

CODE NO.	MOTOROLA PART NO.	DESCRIPTION
1	42C84284B01	RETAINER, screw (Nylon)
2	3515B162	SCREW, lock: No. 4 x 3/8"
3	29C84028H01	TERMINAL, pin (male) 19 used
4	29C84028H02	TERMINAL, pin (male) 7 used
5	26B83779H01	HEAT SINK
6	14A86119G	INSULATOR, transistor
7	26A84598A01	SHIELD, coil
8	26A84598A02	SHIELD, coil
9	55B84300B01	HANDLE

EXCITER

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

ELECTRICAL PARTS LIST

IMPORTANT

USE ONLY THE FOLLOWING MOTOROLA PART NUMBERS WHEN ORDERING REPLACEMENT PARTS

TLD8262B Exciter Board P/O TLD1901A PL-2665-O

		CAPACITOR, fixed: pF; ±5%; 500 V; unless stated
C401	21-84288B59	.01 uF +80-20%; 200 V
C402	21-83596E10	220 ±20%
C403 thru 406	21-84288B59	.01 uF +80-20%; 200 V
C407	8-83813H12	.0047 uF ±10%; 100 V
C408	8-82905C04	.068 uF ±10%; 50 V
C409	21-83406D51	3 ±0.25 pF; NPO
C410	21-83406D55	18; NPO
C412	8-83813H12	.0047 uF ±10%; 100 V
C413	23-83234C70	10 uF +200-10 20 V
C414	8-82905C42	0.33 uF ±10%; 50 V
C415	21-84494D07	150
C416	8-82905C08	.033 uF ±10%; 50 V
C417	21-84494B06	100
C418	21-83406D87	43; NPO
C419	21-84288B59	.01 uF +80-20%; 200 V
C420	23-865137	4.7 uF ±20%; 25 V
C421	21-84288B59	.01 uF +80-20%; 200 V
C422	21-8311325	100 pF ±10%; 300 V
C423	21-82187B14	.001 uF ±10%; 100 V
C425	21-84288B59	.01 uF +80-20%; 200 V
C428	21-83596E13	.001 uF ±10%
C429	21-82610C17	39 ±2%; NPO
C430	21-84494B06	100
C431	21-84288B59	.01 uF +80-20%; 200 V
C432	21-83406D54	4 ±0.25 pF; NPO
C433	21-84494B13	240
C434	21-84494B46	180
C435	21-84288B59	.01 uF +80-20%; 200 V
C436	21-83596E13	.001 uF ±10%
C437	21-84494B24	39
C438	21-864518	1 ±10%
C439	21-84494B01	51
C440	21-84494B06	120
C441	21-84288B59	.01 uF +80-20%; 200 V
C442	21-84494B24	39
C443	21-84494B30	34
C444	21-84288B59	.01 uF +80-20%; 200 V
C445	21-83406D89	10 ±0.5% pF; NPO
C446	21-83406D56	24; NPO
C447	21-83406D87	43; NPO
C448	21-83596E13	.001 uF ±10%
C449	21-83596E13	.001 uF ±10%
C450	21-82428B59	.01 uF +80-20%; 200 V
C451	21-83406D55	18; NPO
C452	21-83406D90	11; NPO
C453	21-82450B06	0.75 ±10%
C454	21-83406D70	5 ±0.5 pF; NPO
C455	21-83406D87	43; NPO
C456	21-83596E13	.001 uF ±10%
C457	21-83406D65	5 ±0.25%; NPO
C458	21-83596E13	.001 uF ±10%
C459	21-83596E10	220 ±20%
C460	21-84494B06	120
C461	21-83596E13	.001 uF ±10%
C462	21-831125	100 pF ±10%; 300 V
CR401	48-82139G01	SEMICONDUCTOR DEVICE, diode: (SEE NOTE) germanium
CR402	48-82392B03	silicon
CR403	48-83654H01	silicon
CR404	48-83654H01	silicon
CR405	48-82392B03	silicon
IC401	51-84312B01	INTEGRATED CIRCUIT: clipper amplifier
IC402	51-84267A02	audio amplifier
J402	9-84207B01	CONNECTOR, receptacle: female; 7-contact

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		COIL, RF:
L401	24-84389B02	18-2/3 turns; coded BLK
L402	24-84389B01	18-1/2 turns; coded YEL
L403	24-84389B06	8-2/3 turns; coded GRN
L404	24-84389B05	8-1/2 turns; coded RED
L405	24-84972A09	6-1/2 turns; coded VIOLET
L406	24-84972A09	6-1/2 turns; coded VIOLET
L407	24-84972A11	5-1/2 turns; coded BLK
L408	24-84972A11	5-1/2 turns; coded BLK
L409	24-84923C01	1-1/2 turns
L410	24-83961B07	2 turns; coded YEL
L411	24-82835C08	choke; 2.6 uH
L412	24-82835C08	choke; 2.6 uH
L413	24-84392B05	9 turns
L415	24-84392B06	40 turns
L416 thru 419	24-83961B01	choke; 3 turns; BRN
P402	1-80709B49	CONNECTOR, plug: male; coaxial; miniature type; includes 4" length of attached coaxial cable
		TRANSISTOR: (SEE NOTE)
Q401	48-869390	N-P-N; type M9390
Q402	48-869571	P-N-P; type M9571
Q403	48-869534	N-P-N; type M9534
Q404	48-869390	N-P-N; type M9390
Q405	48-869591	N-P-N; type M9591
Q406	48-869591	N-P-N; type M9591
		RESISTOR, fixed: ±10%; 1/4 W, unl stated
R401	6-129145	82k
R402	6-128903	39k
R403	6-129862	150
R404	6-127803	1.5k
R406	18-83083G13	var: 10k ±30%
R407	6-129775	330
R408	6-129752	270
R409	6-128685	22k
R410	6-127802	1k
R411	6-131526	18k ±5%
R412	6-131526	18k ±5%
R413	6-124A60	2k ±5%
R414	6-129235	1.2k
R415	6-129804	2.2k ±5%
R416	6-128689	2.2k ±10%
R417	6-127802	470
R420	6-129620	560
R421	6-128902	47k
R422	6-128689	2.2k
R423	6-129757	270
R424	6-128902	47K
R425	6-129232	3.9k
R426	6-128685	22k
R427	6-129863	390
R428	6-2034	15; 1/2 W
R429	6-131652	39

NOTE:

Replacement diodes and transistors must be ordered by Motorola part number only for optimum performance.

TLN5673A Filter Kit (P/O TLD1901A) PL-2666-O

R431 thru R434	6-127803	RESISTOR, fixed: ±10%; 1/4 W 1.5k

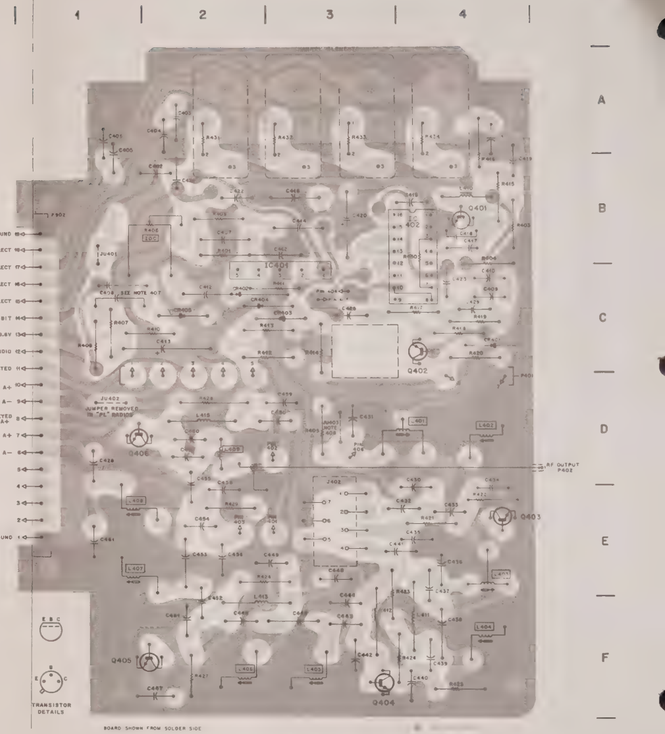
REVISIONS 63P81012E11-E (Sheet 1 of 2)

CHASSIS AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
TLD8262B-2	B424	FROM 6-129144, 680 TO 6-128902, 47K	Q404 BASE
	C408	FROM 8-83813H05, .068 uF ±10%, 100 V TO 8-82905C04, .068 uF ±10%, 50 V	MIC AUDIO INPUT
	C414	FROM 21-83406D55, 18 pF TO 21-83406D89, 10 pF	EXCITER
	L413	FROM 24-82835C25, CHOKE, 1.5 uH TO 24-84392B05, 9 TURNS	Q405 COLLECTOR
	L415	FROM 24-82835C13, CHOKE: 0.82 uH TO 24-84392B06, 40 TURNS	Q405 COLLECTOR
	R429	FROM 6-131641, 22 TO 6-131652, 39	Q406 BASE
TLD8262B-3	C423, 427	FROM 21-83406D55, 18 pF TO 21-82187B14, .001 uF	IC402-6, 7, 11
	C424	FROM 21-83406D55, 18 pF TO 23-82781B08, 1 uF	IC402-8, 14
TLD8262B-4	R416	FROM 6-129753, 105 TO 6-128689, 2.2k	RAMP GENERATOR OUTPUT
TLD8262B-5	R417	FROM 6-129620, 560 TO 6-127802, 470	Q402 EMITTER
	R414	FROM 6-127802, 470 TO 6-129235, 1.2k	P401-6
	C411	DELETED 21-83596E10, 220 pF WAS CONNECTED BETWEEN GROUND AND METER 1 (J402-11).	METER 1 (J402-11
	R405	DELETED 6-128687, 6.8k. WAS CONNECTED BETWEEN C411 AND METER 1 (J402-11).	
	C412	FROM 8-83813H06, 6.1 uF TO 8-83813H11, .0047 uF	
	C422	FROM 21-82428B59, .01 uF TO 21-831125, 100 pF	IC402-5
	CR405	ADDED 48-82392B03	J402-1
	C462	ADDED 21-831125, 100 pF	IC402-4
	R430	ADDED 6-129731, 3.3k	IC401-7
TLD8262B-6	C424	DELETED 21-82781B08, 1 uF WAS CONNECTED BETWEEN PIN 14 OF IC402 AND 14 OF IC402	IC402-8
	C426	DELETED 21-82428B59, .01 uF WAS CONNECTED BETWEEN GROUND AND PIN 13 of IC402	
	C427	DELETED 21-83596E13, .001 uF WAS CONNECTED BETWEEN PINS 11 AND 12 OF IC402	
	R431	ADDED 6-127803, 1.5k	P1-1, 2
TLN4560A-1	R432		P2-1, 2
TLN4677A-1	R433		P3-1, 2
	R434		P4-1, 2

REVISIONS 63P81012E11-E (Sheet 2 of 2)

CHASSIS AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
TLD1901A, TLD5673A		MODELS ADDED	SCHEMATIC DIAGRAM & PARTS LIST
TLD8262B-7	C429	FROM 21-83406D89, 10 pF TO 21-82610C17, 39 pF	PULSE AMPLIFIER
	L416	ADDED 24-83961B01	P401-14
	L417		IC-401-5
	L418		IC-402-5
	L419		Q402 BASE
	R418	DELETED 6-129235, 12k. WAS CONNECTED BETWEEN Q402 BASE AND IC401-8.	PULSE AMPLIFIER
	R419	DELETED 6-129230, 12k. WAS CONNECTED BETWEEN Q402 BASE AND EMITTER.	
	R421	FROM 6-128903, 39k TO 6-128902, 47k	TRIPLER
	R430	DELETED 6-129731, 3.3k. WAS CONNECTED BETWEEN GROUND AND IC401-7.	PULSE AMPLIFIER

EARLIER VERSION TLD8262B-6

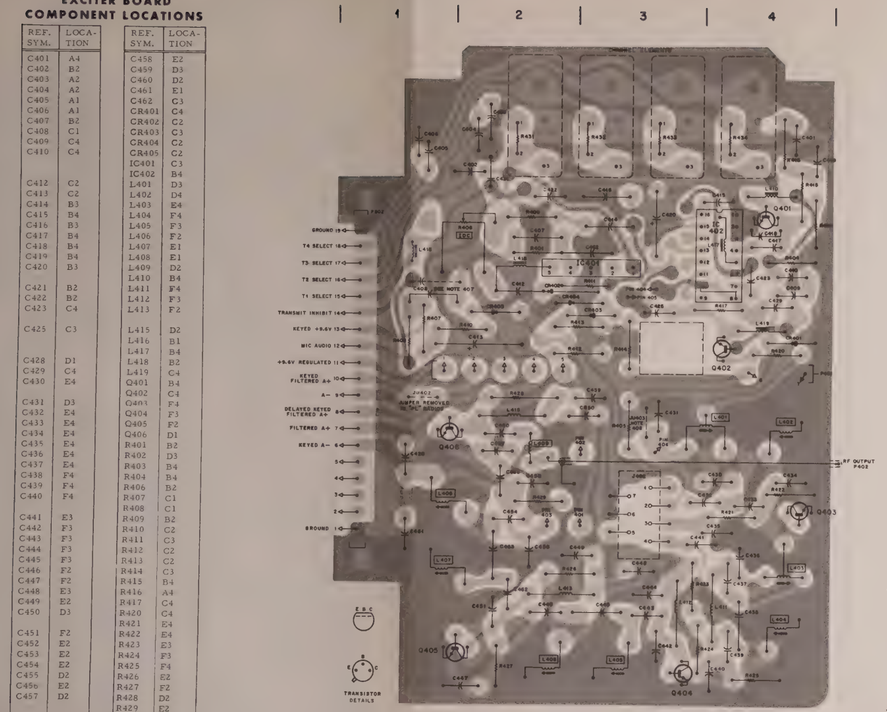


DL-DEPS-6853-O

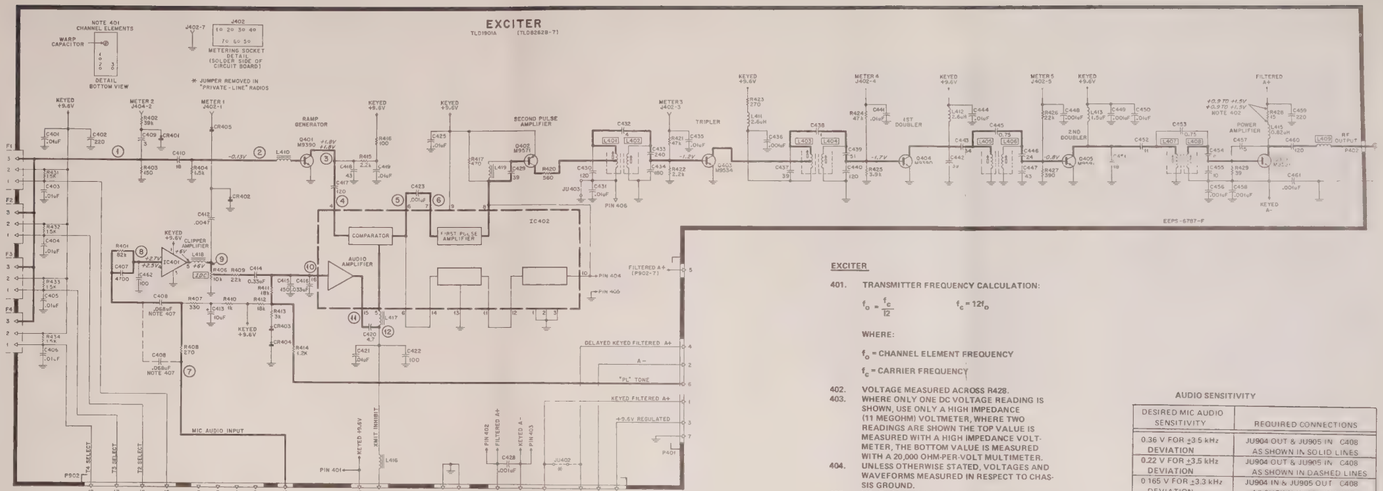
EXCITER BOARD COMPONENT LOCATIONS

REF. SYM.	LOCATION	REF. SYM.	LOCATION
C401	A4	C458	E2
C402	B2	C459	D3
C403	A2	C460	D2
C404	A2	C461	E1
C405	A1	C462	C3
C406	A1	CR401	C4
C407	B2	CR402	C2
C408	C1	CR403	C3
C409	C4	CR404	C2
C410	C4	CR405	C2
		IC401	C3
C412	C2	IC402	B4
C413	C2	L401	D3
C414	B3	L402	D4
C415	B4	L403	E4
C416	B3	L404	F4
C417	B4	L405	F3
C418	B4	L406	F2
C419	B4	L407	E1
C420	B3	L408	E1
		L409	D2
C421	B2	L410	B4
C422	B2	L411	F4
C423	C4	L412	F3
		L413	F2
C425	C3	L415	D2
		L416	B1
		L417	B4
C428	D1	L418	B2
C429	C4	L419	G4
C430	E4	Q401	B4
		Q402	C4
C431	D3	Q403	F4
C432	E4	Q404	F3
C433	E4	Q405	F2
C434	E4	Q406	D1
C435	E4	R401	B2
C436	E4	R402	D3
C437	E4	R403	B4
C438	F4	R404	B4
C439	F4	R406	B2
C440	F4	R407	C1
		R408	C1
C441	E3	R409	B2
C442	F3	R410	C2
C443	F3	R411	C2
C444	F3	R412	C2
C445	F3	R413	C2
C446	F2	R414	C3
C447	F2	R415	B4
C448	E3	R416	A4
C449	E2	R417	C4
C450	D3	R420	C4
		R421	E4
C451	F2	R422	E4
C452	E2	R423	E3
C453	E2	R424	F3
C454	E2	R425	F4
C455	D2	R426	E2
C456	E2	R427	F2
C457	D2	R428	D2
		R429	E2
		R431	B2
		R432	B3
		R433	B3
		R434	B4

EPS-6890-B



EXCITER



EXCITER

401. TRANSMITTER FREQUENCY CALCULATION:

$f_o = \frac{f_c}{12}$ $\quad f_c = 12f_o$

WHERE:

f_o = CHANNEL ELEMENT FREQUENCY

f_c = CARRIER FREQUENCY

402. VOLTAGE MEASURED ACROSS R428.
403. WHERE ONLY ONE DC VOLTAGE READING IS SHOWN, USE ONLY A HIGH IMPEDANCE (11 MEGOHM) VOLTMETER, WHERE TWO READINGS ARE SHOWN THE TOP VALUE IS MEASURED WITH A HIGH IMPEDANCE VOLTMETER, THE BOTTOM VALUE IS MEASURED WITH A 20,000 OHM-PER-VOLT MULTIMETER.
404. UNLESS OTHERWISE STATED, VOLTAGES AND WAVEFORMS MEASURED IN RESPECT TO CHASSIS GROUND.
405. VOLTAGES WILL VARY SLIGHTLY IF +9.6 VOLT SOURCE IS ABOVE OR BELOW NOMINAL VALUE. NORMAL VARIATION FROM RADIO TO RADIO IS 9.1 TO 10.1 VOLTS REGULATED.
406. UNLESS OTHERWISE STATED: CAPACITOR VALUES ARE IN PICOFARADS.
407. SEE AUDIO SENSITIVITY TABLE.

EPS-6780-O

AUDIO SENSITIVITY

DESIRED MIC AUDIO SENSITIVITY	REQUIRED CONNECTIONS
0.36 V FOR ±3.5 kHz DEVIATION	JU904 OUT & JU905 IN C408 AS SHOWN IN SOLID LINES
0.22 V FOR ±3.5 kHz DEVIATION	JU904 OUT & JU905 IN C408 AS SHOWN IN DASHED LINES
0.165 V FOR ±3.3 kHz DEVIATION	JU904 IN & JU905 OUT C408 AS SHOWN IN SOLID LINES
0.100 V FOR ±3.3 kHz DEVIATION	JU904 IN & JU905 OUT C408 AS SHOWN IN DASHED LINES

EPS-7100-O

ALL RF WAVEFORMS TAKEN UNDER FOLLOWING CONDITIONS:

1. TO OBTAIN WAVEFORMS SIMILAR TO THOSE SHOWN, OSCILLOSCOPE MUST HAVE AT LEAST 50 MHz BANDWIDTH, 7 nanosec RISE TIME AMPLIFIER
2. VERTICAL SENSITIVITY SHOWN UNDER EACH WAVEFORM
3. VERTICAL INPUT = DC
4. HORIZONTAL DEFLECTION = 10 nanosec/DIV.
5. TRANSMITTER KEYED.
6. NO MODULATION (REMOVE "VIBRASENDER" REED" REED IN "PL" RADIO).

EPS-6778-O

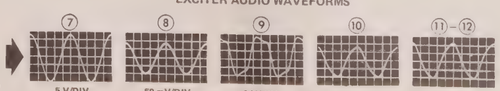
EXCITER RF WAVEFORMS (12.5-14.5 MHz)

ALL AUDIO WAVEFORMS TAKEN UNDER FOLLOWING CONDITIONS:

1. VERTICAL SENSITIVITY SHOWN UNDER EACH WAVEFORM
2. VERTICAL INPUT = AC
3. HORIZONTAL DEFLECTION = 0.2 msec/DIV.
4. 1000 Hz 1 VOLT rms (2.8 V P-P) AUDIO AT MICROPHONE INPUT.
5. "IDC" POT SET FOR +5 kHz DEVIATION.

EPS-6779-O

EXCITER AUDIO WAVEFORMS



PREVIOUS REVISIONS AND PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

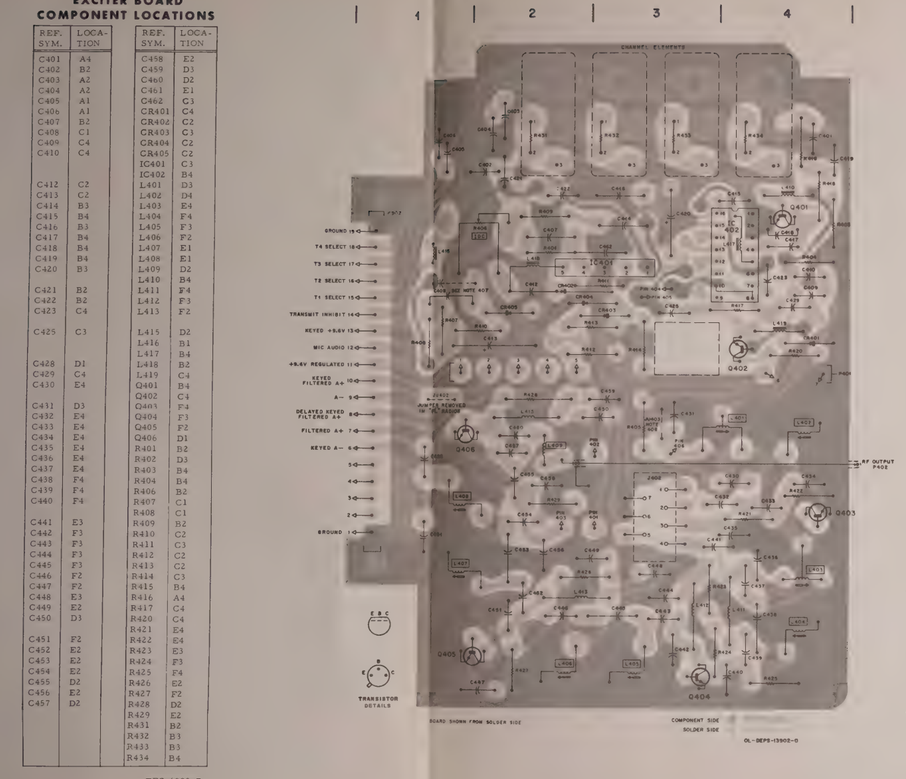
Model T Dash[illegible] Exciter Schematic Diagram and Circuit Board Detail
Motorola No. 63P81012E11-E
7-24-74-PC

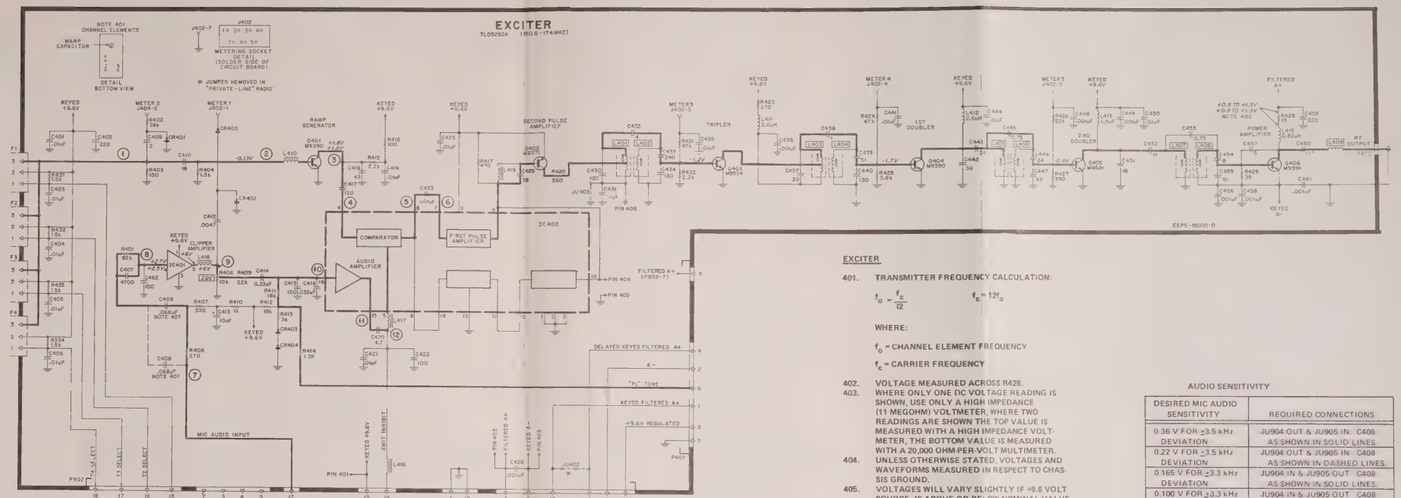
EXCITER BOARD COMPONENT LOCATIONS

REF. SYM.	LOCATION
C401	A4
C402	B2
C403	A2
C404	A2
C405	A1
C406	A1
C407	B2
C408	C1
C409	C4
C410	C4
C412	C2
C413	C2
C414	B3
C415	B4
C416	B3
C417	B4
C418	B4
C419	B4
C420	B3
C421	B2
C422	B2
C423	C4
C425	C3
C428	D1
C429	C4
C430	E4
C431	D3
C432	E4
C433	E4
C434	E4
C435	E4
C436	E4
C437	E4
C438	F4
C439	F4
C440	F4
C441	E3
C442	F3
C443	F3
C444	F3
C445	F3
C446	F2
C447	F2
C448	E3
C449	E2
C450	D3
C451	F2
C452	E2
C453	E2
C454	E2
C455	D2
C456	E2
C457	D2

REF. SYM.	LOCATION
C458	E2
C459	D3
C460	D2
C461	E1
C462	C3
CR401	C4
CR402	C2
CR403	C3
CR404	C2
CR405	C2
IC401	C3
IC402	B4
L401	D3
L402	D4
L403	E4
L404	F4
L405	F3
L406	F2
L407	E1
L408	E1
L409	D2
L410	B4
L411	F4
L412	F3
L413	F2
L415	D2
L416	B1
L417	B4
L418	B2
L419	C4
Q401	B4
Q402	C4
Q403	F4
Q404	F3
Q405	F2
Q406	D1
R401	B2
R402	D3
R403	B4
R404	B4
R406	B2
R407	C1
R408	C1
R409	B2
R410	C2
R411	C3
R412	C2
R413	C2
R414	C3
R415	B4
R416	A4
R417	C4
R420	C4
R421	E4
R422	E4
R423	E3
R424	F3
R425	F4
R426	E2
R427	F2
R428	D2
R429	E2
R431	B2
R432	B3
R433	B3
R434	B4

EPS-6890-B





EXCITER

401. **TRANSMITTER FREQUENCY** CALCULATION:

$f_o = \frac{f_c}{12}$ $\quad f_c = 12 f_o$

WHERE:

f_o = **CHANNEL ELEMENT FREQUENCY**

f_c = **CARRIER FREQUENCY**

402. **VOLTAGE MEASURED ACROSS R428.**
403. **WHERE ONLY ONE DC VOLTAGE READING IS SHOWN, USE ONLY A HIGH IMPEDANCE (11 MEGOHM) VOLTMETER. WHERE TWO READINGS ARE SHOWN THE TOP VALUE IS MEASURED WITH A HIGH IMPEDANCE VOLTMETER, THE BOTTOM VALUE IS MEASURED WITH A 20,000 OHM-PER-VOLT MULTIMETER.**
404. **UNLESS OTHERWISE STATED, VOLTAGES AND WAVEFORMS MEASURED IN RESPECT TO CHASSIS GROUND.**
405. **VOLTAGES WILL VARY SLIGHTLY IF +9.6 VOLT SOURCE IS ABOVE OR BELOW NOMINAL VALUE. NORMAL VARIATION FROM RADIO TO RADIO IS 9.1 TO 10.1 VOLTS REGULATED.**
406. **UNLESS OTHERWISE STATED: CAPACITOR VALUES ARE IN PICOFARADS.**
407. **SEE AUDIO SENSITIVITY TABLE.**

AUDIO SENSITIVITY

DESIRED MIC AUDIO SENSITIVITY	REQUIRED CONNECTIONS
0.36 V FOR ±3.5 kHz DEVIATION	JU904 OUT & JU905 IN: C408 AS SHOWN IN SOLID LINES.
0.22 V FOR ±3.5 kHz DEVIATION	JU904 OUT & JU905 IN: C408 AS SHOWN IN DASHED LINES.
0.165 V FOR ±3.3 kHz DEVIATION	JU904 IN & JU905 OUT: C408 AS SHOWN IN SOLID LINES.
0.100 V FOR ±3.3 kHz DEVIATION	JU904 IN & JU905 OUT: C408 AS SHOWN IN DASHED LINES.

EPS-7100-O

ALL RF WAVEFORMS TAKEN UNDER FOLLOWING CONDITIONS:

1. TO OBTAIN WAVEFORMS SIMILAR TO THOSE SHOWN, OSCILLOSCOPE MUST HAVE AT LEAST 50 MHz BANDWIDTH, 7 nanosec RISE TIME AMPLIFIER.
2. VERTICAL SENSITIVITY SHOWN UNDER EACH WAVEFORM
3. VERTICAL INPUT – DC.
4. HORIZONTAL DEFLECTION = 10 nanosec/DIV.
5. TRANSMITTER KEYED
6. NO MODULATION (REMOVE "VIBRASENDER" REED" REED IN "PL" RADIO).

EPS-6778-O

EXCITER RF WAVEFORMS (12.5-14.5 MHz)

EPS-6780-O

ALL AUDIO WAVEFORMS TAKEN UNDER FOLLOWING CONDITIONS:

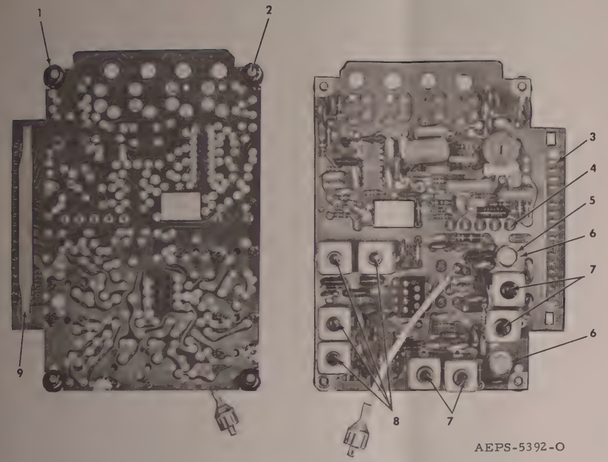
1. VERTICAL SENSITIVITY SHOWN UNDER EACH WAVEFORM.
2. VERTICAL INPUT – AC.
3. HORIZONTAL DEFLECTION = 0.2 msec/DIV.
4. 1000 Hz 1-VOLT rms (2.8 V P-P) AUDIO AT MICROPHONE INPUT.
5. "IDC" POT SET FOR +5 kHz DEVIATION.

EPS-6779-O

EXCITER AUDIO WAVEFORMS

PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

Model TLD5202A Exciter Schematic Diagram and Circuit Board Detail
Motorola No. PEPS-14999-O
7/29/74-NPC



AEPS-5392-O

MECHANICAL PARTS LIST

TLD5282A Exciter PL-2873-O

CODE NO.	MOTOROLA PART NO.	DESCRIPTION
1	42C84284B01	RETAINER, screw (Nylon)
2	3S138162	SCREW, lock: No. 4 x 3/8"
3	29C84028H01	TERMINAL, pin (male) 19 used
4	29C84028H02	TERMINAL, pin (male) 7 used
5	26B83379H01	HEAT SINK
6	14A86119G	INSULATOR, transistor
7	26A84598A01	SHIELD, coil
8	26A84598A02	SHIELD, coil
9	55B84390B01	HANDLE

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

ELECTRICAL PARTS LIST

IMPORTANT

USE ONLY THE FOLLOWING MOTOROLA PART NUMBERS WHEN ORDERING REPLACEMENT PARTS

TLD5282A Exciter Board PL-2874-O

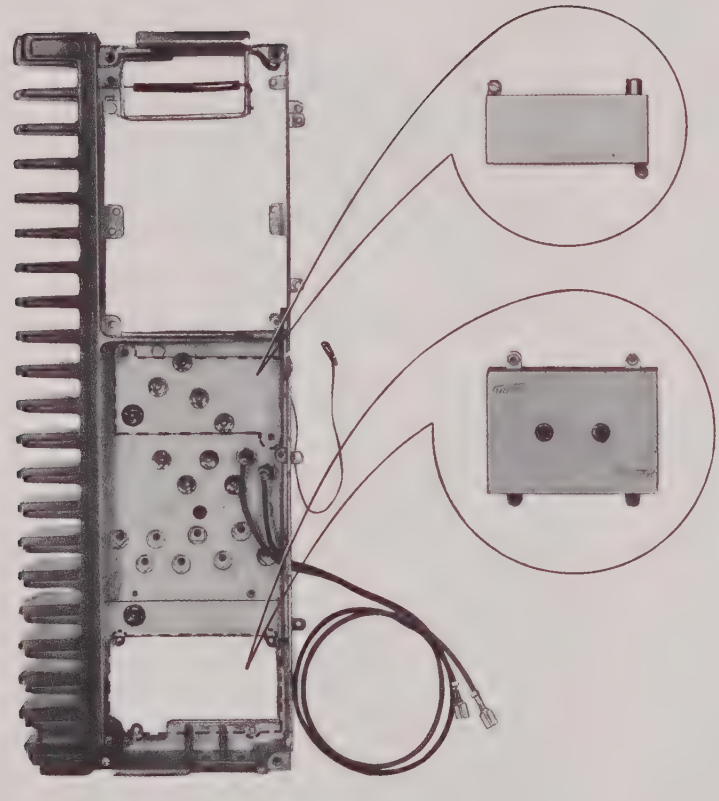
		CAPACITOR, fixed: pF, ±5%; 500 V, unl stated
C401	21-82428B59	.01 uF +80-20%; 200 V
C402	21-8359E10	220 ±20%
C403 thru 406	21-82428B59	.01 uF +80-20%; 200 V
C407	8-83813M12	.0047 uF ±10%; 100 V
C408	8-82905C04	.068 uF ±10%; 50 V
C409	21-83406D51	1 ±0.25 pF; NPO
C410	21-83406D55	18; NPO
C412	8-83813M12	.0047 uF ±10%; 100 V
C413	23-83214C20	10 uF +20% -10 V
C414	8-82905C42	0.33 uF ±10%, 50 V
C415	21-84494B07	150
C416	8-82905C08	.033 uF ±10%; 50 V
C417	21-84494B06	120
C418	21-83406D87	43; NPO
C419	21-82428B59	.01 uF +80-20%; 200 V
C420	23-865137	4.7 uF ±20%; 25 V
C421	21-82428B59	.01 uF +80-20%, 200 V
C422	21-831125	100 pF ±10%; 100 V
C423	21-82187B14	.001 uF ±10%; 100 V
C425	21-82428B59	.01 uF +80-20%; 200 V
C428	21-83596E13	.001 uF ±10%
C429	21-82610C17	39 ±2%; NP0
C430	21-84494B06	120
C431	21-82428B59	.01 uF +80-20%; 200 V
C432	21-83406D54	4 ±0.25 pF; NP0
C433	21-84494B13	240
C434	21-84494B46	180
C435	21-82428B59	.01 uF +80-20%; 200 V
C436	21-83596E13	.001 uF ±10%
C437	21-84494B24	39
C438	21-864518	1 ±10%
C439	21-84494B01	51
C440	21-84494B06	120
C441	21-82428B59	.01 uF +80-20%; 200 V
C442	21-84494B24	39
C443	21-84494B30	34
C444	21-82428B59	.01 uF +80-20%; 200 V
C445	21-83406D89	10 ±0.5% pF; NP0
C446	21-83406D56	24; NP0
C447	21-83406D87	43; NP0
C448	21-83596E13	.001 uF ±10%
C449	21-83596E13	.001 uF ±10%
C450	21-82428B59	.01 uF +80-20%; 200 V
C451	21-83406D55	18; NP0
C452	21-83406D90	11; NP0
C453	21-82450B06	6.75 ±10%
C454	21-83406D70	8 ±0.5 pF; NP0
C455	21-83406D87	43; NP0
C456	21-83596E13	.001 uF ±10%
C457	21-83406D65	5 ±0.25%; NP0
C458	21-83596E13	.001 uF ±10%
C459	21-8359E10	220 ±20%
C460	21-84494B06	120
C461	21-83596E13	.001 uF ±10%
C462	21-831125	100 pF ±10%, 100 V
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR401	48-82139G01	germanium
CR402	48-82392B03	silicon
CR403	48-83654H01	silicon
CR404	48-83654H01	silicon
CR405	48-82392B03	silicon
		INTEGRATED CIRCUIT:
IC401	51-84312B01	clipper amplifier
IC402	51-84267A02	audio amplifier
		CONNECTOR, receptacle:
J402	9-84207B01	female; 7-contact

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		COIL, RF:
L401	24-84389B02	18-2/3 turns; coded BLK
L402	24-84389B01	18-1/2 turns; coded YEL
L403	24-84389B06	8-2/3 turns; coded GRN
L404	24-84389B05	8-1/2 turns; coded RED
L405	24-84972A09	6-1/2 turns; coded VIOLET
L406	24-84972A09	6-1/2 turns; coded VIOLET
L407	24-84972A11	3-1/2 turns; coded BLK
L408	24-84972A11	3-1/2 turns; coded BLK
L409	24-84923C01	1-1/2 turns
L410	24-83961B07	2 turns; coded YEL
L411	24-82835G08	choke; 2.6 uH
L412	24-82835G08	choke; 2.6 uH
L413	24-84392B05	9 turns
L415	24-84392B06	40 turns
L416 thru 419	24-83961B01	choke; 3 turns; BRN
P402	1-80709B49	CONNECTOR, plug: male; coaxial; miniature type; includes 4" length of attached coaxial cable
		TRANSISTOR: (SEE NOTE)
Q401	48-869390	N-P-N; type M9390
Q402	48-869571	P-N-P; type M9571
Q403	48-869534	N-P-N; type M9534
Q404	48-869390	N-P-N; type M9390
Q405	48-869591	N-P-N; type M9591
Q406	48-869591	N-P-N; type M9591
		RESISTOR, fixed: ±10%; 1/4 W; unl stated
R401	6-129145	82k
R402	6-128903	39k
R403	6-129862	150
R404	6-127803	1.5k
R405	18-83083C13	var; 10k ±30%
R407	6-129775	330
R408	6-129792	270
R409	6-128685	22k
R410	6-127802	1k
R411	6-131526	18k ±5%
R412	6-131526	18k ±5%
R413	6-124A80	3k ±5%
R414	6-129235	1.2k
R415	6-129804	2.2k ±5%
R416	6-128689	2.2k ±10%
R417	6-127802	470
R420	6-129620	560
R421	6-128902	47k
R422	6-128689	2.2k
R423	6-129752	270
R424	6-128902	47K
R425	6-129232	3.9k
R426	6-128685	22k
R427	6-129863	390
R428	6-2034	15; 1/2 W
R429	6-131652	39
R431 thru R434	6-127803	1.5k

NOTE: Replacement diodes and transistors must be ordered by Motorola part number only for optimum performance.

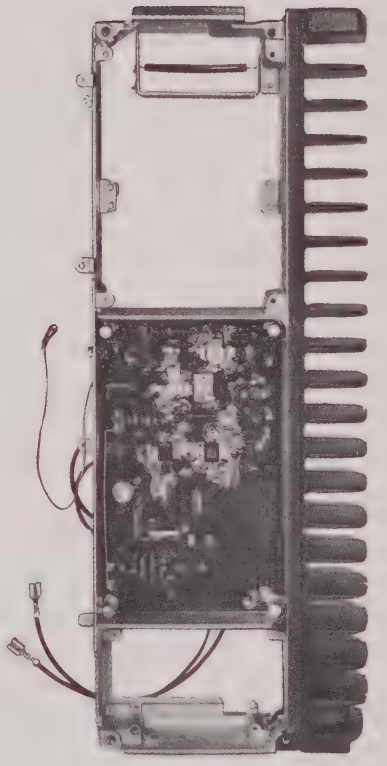
45 W POWER AMPLIFIER

TLD1600A SERIES



BOTTOM VIEW

BEPS-6897-O



TOP VIEW

MODEL	FREQ. RANGE
TLD1633A	150.8-162 MHz
TLD1634A	162-174 MHz

TECHNICAL CHARACTERISTICS	
RF Power In	400 mV
Input Impedance	50 ohms
RF Power Out	45 watts
Output Impedance	50 ohms

45 W POWER AMPLIFIER

MOTOROLA INC. **Communications Division**

ENGINEERING PUBLICATIONS 1301 E. ALGONQUIN ROAD SCHAUMBURG, ILLINOIS 60172

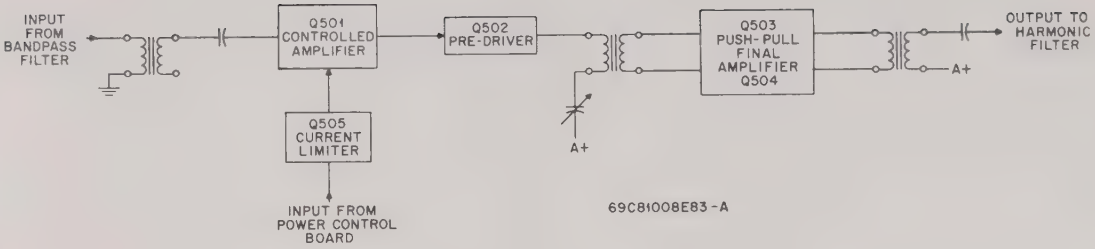


Figure 1.
Block Diagram

1. DESCRIPTION

Motorola's TLD1600A Series Power-Amplifiers provide the following features:

-- A minimum of 45 W RF output.

-- All circuitry except power transistors contained on one single-sided circuit board.

-- Power transistors mounted directly to (but electrically isolated from) the heat sink.

-- RF connections made through two coaxial connectors which plug directly into the input and output filter assemblies located below the heat sink shelf.

-- DC power supplied via two feed-through capacitors that also provide filtering.

-- Input, output and all other interstage matching (with the exception of a single fixed-tuned matching network between the controlled amplifier stage and the driver stage) is accomplished by the use of rf transformers wound around ferrite cores. Only one tuning adjustment is required due to the relatively broadband matching characteristics of the ferrite transformers and the low inductance leads of the silicon opposed emitter transistors.

-- One metering socket which is accessible from the component side of the circuit board allows three major test points to be monitored and permits measurement of the dc current drawn by the final amplifier stage.

-- Due to the heat sink mounting requirements for this board, servicing is accomplished from the component side of the board.

-- Diode protection against reverse polarity voltage (board mounted diode).

-- Output protection provided by current limiter transistor driven by power control circuit (controls gain of the first stage). Single-wire w/push-on connector provides interconnection between power control and PA circuitry.

-- No high voltage required; operates directly from 13.6 volts.

2. FUNCTIONAL OPERATION

Refer to the block diagram, Figure 1, and the schematic diagram. This series of power amplifiers requires a 400 mW rf input from the exciter board. This input is passed through a bandpass filter assembly and a ferrite step-down transformer (to match the input impedance to the first stage) to the gain-controlled amplifier stage. The external power control circuit which drives the current limiter transistor determines the gain of this stage. The power control circuit monitors the output of the final stages of the power amplifier, the load condition and the heat sink temperature.

The output of the gain controlled amplifier is passed through a fixed-tuned broadband, matching network and applied to the driver stage. A second ferrite transformer is utilized to match the single-ended output of the driver stage to the input of the push-pull power amplifier stage. The output from the final stage is stepped up in impedance by a ferrite transformer and paralleled to provide the 50-ohm output impedance to match the input impedance of the harmonic filter.

Pin 1 of the metering receptacle provides a means of checking the incoming signal from the exciter. Pin 2 permits observation of the drive output of the first stage and an indication of the operation of the driver stage. Pin 3 reflects the drive signal and operation of the two push-pull power amplifier stages. Reference position A on the Motorola Portable Test Set uses pin 7 of the

metering socket as an A+ reference against which the outputs of pins 1, 2, & 3 are checked. Switch the test set to reference position B which uses pin 6 as a reference and then switch to meter position 5. This provides a reading across a calibrated resistor through which the current is drawn by the final amplifier stages.

3. MAINTENANCE

a. General

NOTE

Because of the complexity involved and time required to remove the PA board, compared to plug-in boards, it is not recommended that the PA board be removed. Proper troubleshooting techniques will usually locate defective components "on the spot". Removal and replacement instructions, however, are given in the event removal is necessary.

This section of the manual provides the maintenance shop procedures for the PA board. It assumes that preliminary tests have already localized the trouble to the PA board. These procedures include measurements with a Motorola portable test set, a vom, a complete set of performance tests and extensive troubleshooting procedures.

CAUTION

The PA board must be installed in a radio set for testing to provide the necessary power, ground control, heat sinking and signal connections.

b. Recommended Test Equipment

The following test equipment is the minimum required for troubleshooting and adjusting the PA. All such equipment is battery operated which permits testing to be performed in the field where no commercial power is available for bench type test equipment.

(1) Motorola S1056A through S1059A Portable Test Set and Model TEK-37A Adapter Cable. The portable test set is required for checking each stage for proper operation.

(2) A Motorola Solid-State DC Multimeter or a 20,000 ohm-per-volt multimeter should be used, however, a low impedance multimeter is acceptable for dc voltage measurements only.

(3) Motorola T1013A RF Load Resistor (dummy load) or equivalent.

CAUTION

Care must be exercised if the radio is to be bench tested by the application of 12-volts directly to the radio transmitter and/or receiver stages. The power supply deck provides overvoltage and surge protection for these circuits; hence, an external power supply feeding the rf circuits directly must be well enough regulated to provide supply voltages that remain below harmful levels. Such a supply must provide a terminal voltage of 13.4 volts under full load with the transmitter keyed, but not exceed 16.5 volts (including transients) when switched to the no load (unkeyed) condition. Most power supplies will not meet this requirement; in fact, some SCR regulated power supplies have transient response that allows the output voltage to momentarily triple when switched from full load to no load. The following bench supplies are approved for testing the "Micor" radio when the power supply deck is bypassed:

Motorola S1303A or S1305A Regulated Power Supply.

Motorola T1261A Transistorized 24-Volt to 12-Volt Converter driven by a Motorola T1012A Power Supply.

12-Volt automotive battery with a Motorola T1012A Power Supply used as a battery charger.

c. Test Set Metering

The PA is equipped with a metering receptacle which allows four major test points to be measured on a Motorola portable test set. The portable test set can be connected to the PA metering receptacle and readings made at each of the test points by merely rotating a selector switch on the test set. A failure in almost any portion of the PA will produce a low or zero meter reading for one or more of the test points. Improper alignment will also cause improper meter readings.

To make the measurements, the portable test set must be connected to the radio set as shown in Figure 2 and listed in the following procedure.

(1) Set the function selector switch of the portable test set to the XMTR position.

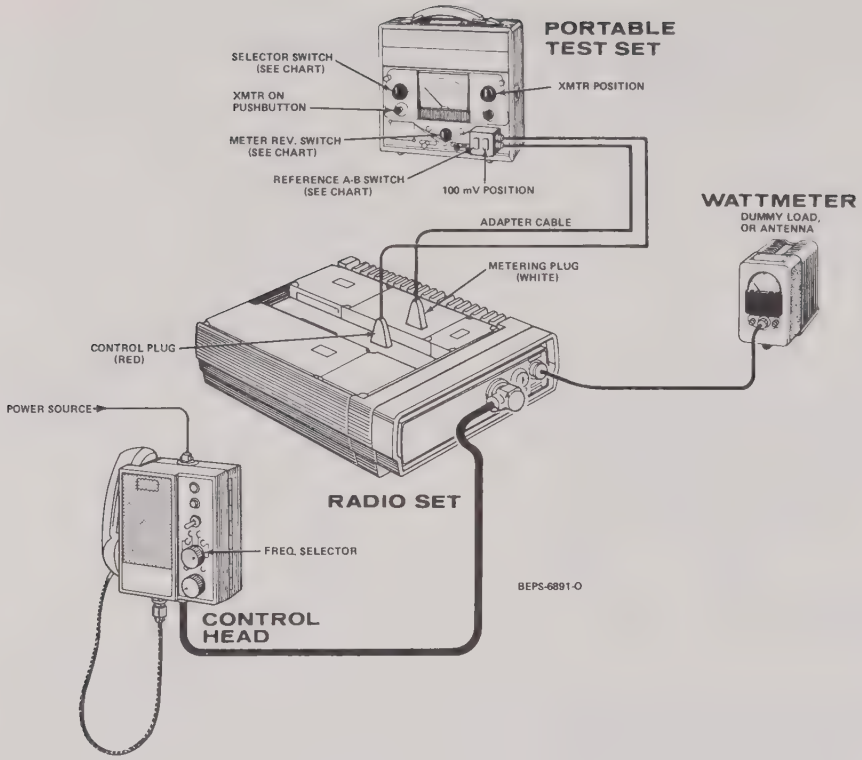


Figure 2.
PA Metering Test Set-Up

(2) Set the meter reversing switch of the test set to the METER REV position, the selector switch to position 1 and reference switch to position A.

(3) Connect the 20-pin meter cable plug to the test set. When the test set is not in use, disconnect the 20-pin plug to conserve battery life. The plug acts as an on-off switch completing the battery circuit.

(4) Connect the red "control" plug of the adapter cable to the receptacle on the control circuit board of the radio set. Connect the white "metering" plug of the adapter cable to the receptacle on the PA circuit board.

(5) The entire transmitter is necessary for testing PA boards including the power control board for proper control.

(6) The output of the radio must be terminated in one of three types of loads:

-- The antenna load.

-- A dummy load such as Motorola's T1013A RF Load Resistor.

-- An RF wattmeter.

NOTE

A dummy load is preferred to the antenna to eliminate the possibility of shutback by the power control board due to a defective antenna.

(7) Connect power to the radio set.

(8) Key the transmitter with the XMTR ON button on the test set. Observe meter 1. Unkey the transmitter.

(9) Set the selector switch to positions 2 & 3, then switch to reference position B and switch to meter position 5 respectively, keying the transmitter and observing the meter reading for each. on multi-frequency radio sets, repeat the readings for each exciter frequency. An analysis of the meter readings for determining whether each circuit is good or bad follows:

Each time maintenance is performed on the PA, the readings should be compared with the previous set of readings. Any degradation of performance will quickly be noted. Often, a lower reading may indicate an impending failure and corrective action may be taken before the circuit fails entirely.

MINIMUM PA METER READINGS

SELECTOR SWITCH POSITION	REFERENCE SWITCH POSITION	MINIMUM METER READINGS	CIRCUIT METERED	IF LOW, DEFECTIVE CIRCUIT IS: (SEE TROUBLESHOOTING CHARTS)
1	A	15 uA	Exciter Output (Input to Controlled Ampl. Stage Q501)	Exciter output, input circuit of controlled ampl. stage Q501
2	A	5 uA	Input of Driver Stage Q502	Output of controlled amplifier stage, input circuitry of driver stage Q502.
3	A	15 uA	Input to Final Ampl. Stage Q503, Q504	Output of driver stage Q502. Input circuit of final ampl. Q503, Q504
4	NOT USED			
5	B	25-40 uA (Minimum-Maximum) for 45 watts RF Power Output	Total Current of Final Ampl. Stage Q503, Q504	Output of final ampl. stage Q503, Q504, power control board, antenna switch, antenna
6	B	12 V (0-30 V scale)	Final Ampl. Voltage	Final ampl, A+ or A- inputs

d. Performance Tests

(1) No performance test of the power amplifier is required other than rf power output from the radio as a whole. Before checking power output:

(a) The exciter board should be known to be operating normally.

(b) The power control board should be known to be functioning normally.

(c) The antenna switch should be known to be functioning normally.

(2) Key the transmitter and observe power out which should be 45 watts.

(3) If necessary, adjust POWER SET control for rated power output.

e. Removal and Replacement

Refer to Figure 3 for instructions to remove and replace the PA circuit board. The PA shield must always be in place during operation of the radio set and should be kept in place as much as possible while testing and troubleshooting. The circuit board must always be secured in place with all mounting screws. The transistors (including the control transistors mounted on the inner wall) must be secured in place to provide proper heat sinking, and the feedthrough connectors must be soldered in place to provide dc power and good rf grounding.

4. TROUBLESHOOTING

If a problem has been localized to the PA deck, several checks can be made prior to extensive troubleshooting.

a. Visual

Visually check for obvious physical defects such as broken leads, broken plating, broken or disconnected components or overheated parts. Before any attempt is made to change parts, the circuit should be checked to insure that the problem causing the original failure has been identified and corrected, otherwise damage to the new part may occur.

b. Voltage Checks

Check for A+ and A- at the feedthrough connections and for proper voltages at the collectors of each transistor. Certain defects such as broken plating, broken leads etc. may not be obvious to a visual inspection.

c. Troubleshooting

If test set readings are abnormal or tests indicate subnormal performance, logical

troubleshooting procedure is required to isolate the defective component efficiently. The accompanying troubleshooting charts summarize these results in a logical sequence. A few voltage and resistance checks in the suspected circuit should readily isolate the defective component.

CAUTION

Due to the voltage requirements of P-N-P transistors, all "RF ground" plating is A+ and is "hot" with respect to chassis ground in negative ground vehicles. Because of this, caution should be used to prevent connection of "ground" plating on the PA board to chassis ground either directly or by the use of test equipment ground leads. If ac operated test equipment is used, the ground lead must not be electrically connected to ac line ground.

The schematic diagram of the PA board contains the voltage readings required for troubleshooting. The readings are typical for normal operating conditions at rated power output for the radio. Refer to troubleshooting charts and the schematic when a defect is suspected in the PA board.

5. PA REPAIR NOTES

a. Resistance Measurements of Transistors in Push-Pull Pairs

Due to the fact that transistors in push-pull pairs are dc connected at both base and emitter, BOTH devices should be measured when a defect in the pair is suspected.

b. Transistor Removal Procedure

(1) Unscrew both mounting screws from the base of the transistor. The nuts for the mounting screws on the reverse side of the shelf are captivated and will not fall out.

(2) Remove excess solder from around transistor tabs with a vacuum bulb type desoldering device.

(3) Gently lift each lead, one at a time while applying heat.

(4) When all four leads are loose from the board, carefully lift out the transistor.

c. Transistor Installation Procedure

(1) Pre-tin underside of each transistor lead.

(2) Apply a light coat of Wakefield Thermal Compound to the underside of the transistor mounting base and to the heat sink.

(3) Install the transistor making sure that all collector leads except on Q501, face the front of the radio. The collector lead of Q501 faces the inner wall of the radio. Refer to the circuit board detail.

(4) Screw down the two mounting screws securely.

(5) Solder each transistor lead one at a time to the circuit board. The use of a generous amount of solder will insure good contact of the entire tab to the board. Use care that solder does not bridge to other plating or that solder does not flow into the cutout in the circuit board.

d. Procedure for Resistance Measurements of Transistors

(1) Set ohmmeter to RX1, RX10, or RX100 scale (preferably RX10 if available).

(2) Measure the resistance from lead to lead as described:

(a) With the positive probe on the base, no indication (very high impedance) should be observed when the negative probe is touched to the collector or emitter. (Reverse drop measurement.)

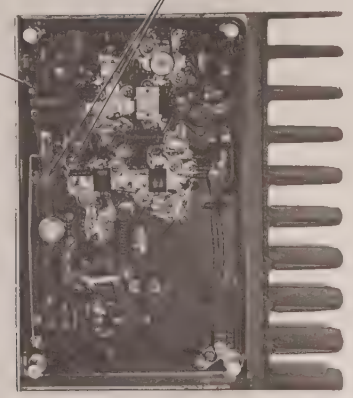
(b) With the negative probe on the base, a relatively low impedance should be observed when touching the positive probe to the collector and emitter. (Forward drop measurement.)

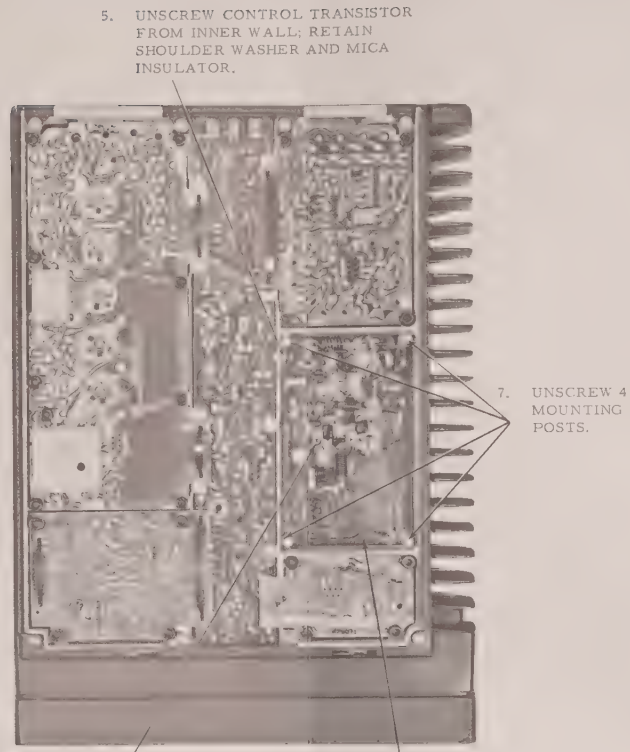
(c) No indication should be observed from collector to emitter regardless of the polarity of the ohmmeter probes.

Should any indication be observed in measurements (a) or (c), the transistor is defective and should be replaced.

REMOVAL PROCEDURE

1. TURN OFF RADIO POWER.
2. REMOVE POWER AMPLIFIER SHIELD.



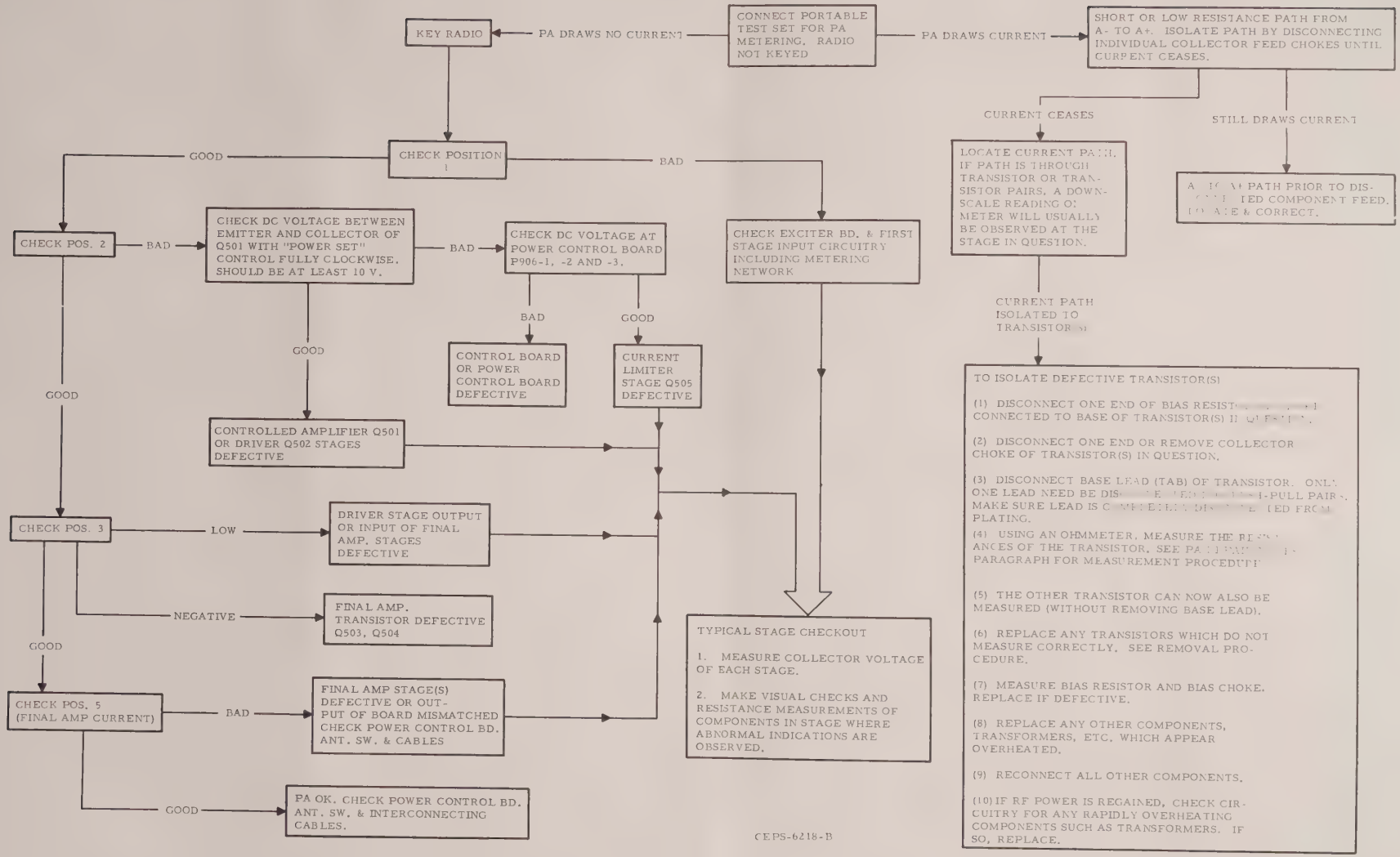


REPLACEMENT PROCEDURE

10. RESOLDER BLUE CONTROL LEAD.
11. REPLACE BOARD MAKING SURE CONNECTORS AND HOLES ARE LINED UP.
12. REPLACE MOUNTING POSTS.
13. REPLACE CONTROL TRANSISTOR, WASHER, AND INSULATOR IN CORRECT ORDER.
14. RESOLDER A+ AND A- LEADS.
15. IF TRANSISTORS WERE REMOVED, REPLACE AS SHOWN; INSERT AND TIGHTEN SCREWS BEFORE RESOLDERING TABS.

Figure 3.
Removal and Replacement of PA Circuit Board

45 WATT POWER AMPLIFIER
TROUBLESHOOTING CHART



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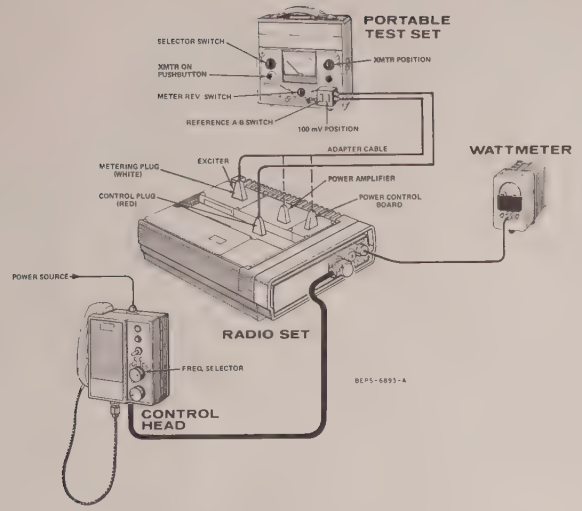


Alignment Set-Up

EXCERPTS FROM FCC REGULATIONS

FCC Regulations state that:

1. Radio transmitters may be tuned or adjusted only by persons holding a first or second class commerical radiotelephone operator's license or by personnel working directly under their immediate supervision.
2. The power input to the final radio frequency stage shall not exceed the maximum figure specified on the current station authorization. This power input shall be measured and the results recorded:

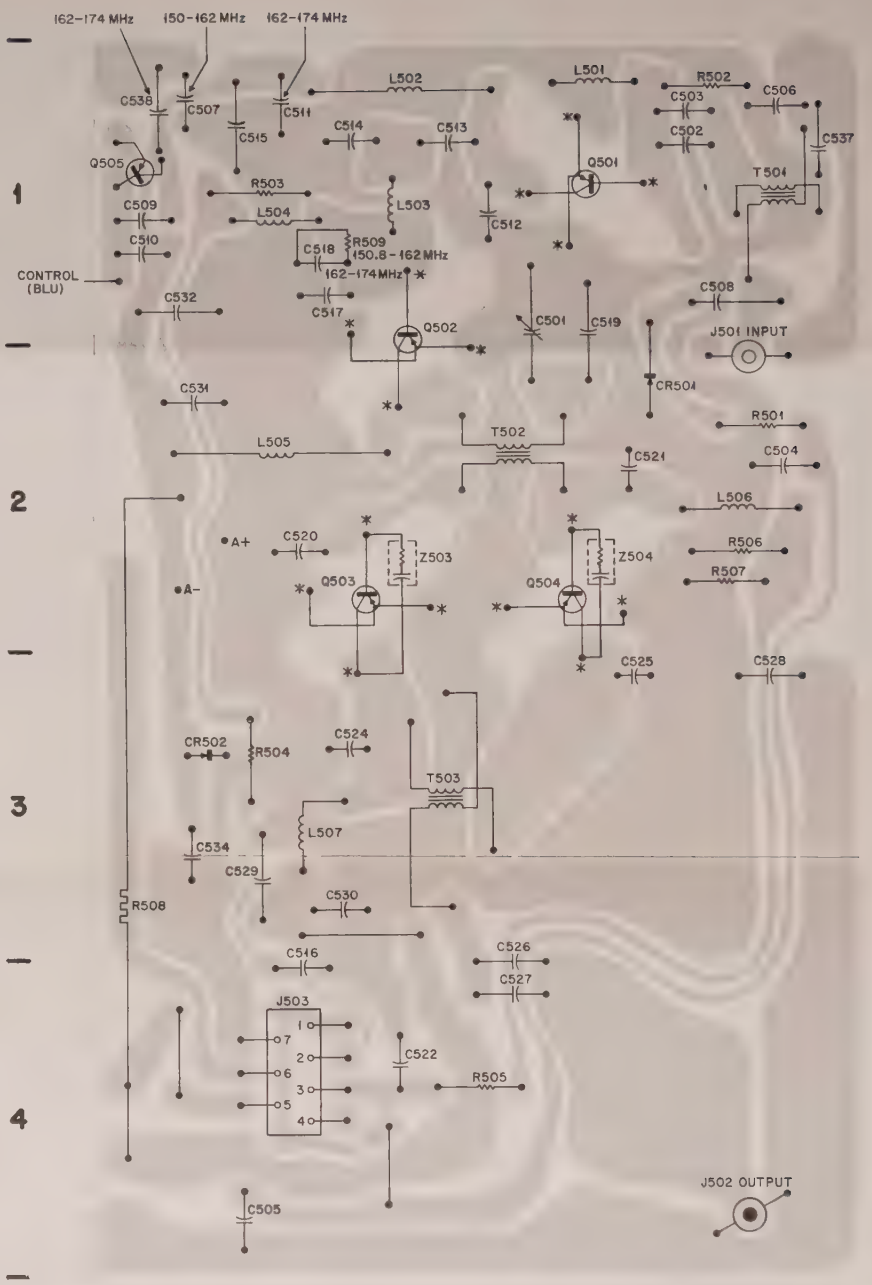
   a. When the transmitter is initially installed.
   b. When any change is made in the transmitter which may increase the power input.
   c. At intervals not to exceed one year.

3. Frequency and deviation of a transmitter must be checked:

   a. When it is initially installed.
   b. When any change is made in the transmitter which may affect the carrier frequency or modulation characteristics.
   c. At intervals not to exceed one year.

POWER AMPLIFIER ALIGNMENT PROCEDURE

STEP	ADJUST	METERING PLUG LOCATION	TEST SET SELECTOR SWITCH POSITION	METER REV. & ADAPTER CABLE REF. SWITCHES	STAGE & PROCEDURE
1					Align the exciter.
2					For complete power amplifier tune-up, proceed with step 3. To check alignment, move metering plug to power control board and go to step 7.
3	C501				PA PRE-ALIGNMENT - Set capacitor C501 fully clockwise.
4	POWER SET C501	POWER CONTROL BOARD	5	METER REV. REF B	OUTPUT - Move metering plug to the power control board. Gradually rotate the POWER SET control until an initial meter 5 reading is observed. Do not readjust POWER SET control. If this indication is less than 50 uA (full scale), proceed with step 5. If this indication is greater than 50 uA, tune C501 for an on-scale reading.
5	POWER SET	POWER CONTROL BOARD	Wattmeter or 1	METER REV. REF A	OUTPUT - Without exceeding rated power output of 45 watts on wattmeter or calibration label value on meter 1, adjust the POWER SET control for rated power or until no further increase in power output is observed. Then adjust the POWER SET control counterclockwise for an approximate 5 W reduction on the wattmeter or 3 uA reduction from meter 1 reading.
6	C501	POWER CONTROL BOARD	5	METER REV. REF B	PA DRIVER OUTPUT - Tune C501 for minimum meter 5 reading.
7	POWER SET	POWER CONTROL BOARD	Wattmeter or 1 5	METER REV. REF A METER REV. REF B	OUTPUT - Adjust the POWER SET control for rated power output and repeat step 6 (if rated power cannot be attained, repeat steps 5 and 6). For continuous duty operation, adjust POWER SET control for 40 W. Check meter 5 reading, it must not exceed 50 uA.
8		PA	5	METER REV. REF B	FINAL COLLECTOR CURRENT - Move the metering plug to the PA. Measure the final collector current (Ic). Ic in amperes is the meter 5 reading (0-50) x 2.
9		PA	6	METER REV. REF B	FINAL COLLECTOR VOLTAGE - Measure the final collector voltage (Vc). Vc is the meter 6 reading (0-30 volt scale).
10					Determine final input power (Pin). Pin equals Vc x Ic. Pin should be less than 90 watts.



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POWER AMPLIFIER COMPONENT LOCATIONS

REF. SYM.	LOCATION	REF. SYM.	LOCATION
C501	B1	C532	A1
C502	C1	C534	A3
C503	C1	C537	C1
C504	C2	C538	A1
C505	A4	CR501	C2
C506	C5	CR502	A3
C507	A1	L501	B1
C508	C1	L502	B1
C509	A1	L503	B1
C510	A1	L504	A1
		L505	A2
C511	A1	L506	C2
C512	B1	L507	A3
C513	B1	Q501	B1
C514	A1	Q502	B1
C515	A1	Q503	B2
C516	A4	Q504	B2
C517	A1	Q505	A1
C518	A1	R501	C2
C519	B1	R502	C1
C520	A2	R503	A1
		R504	A3
C521	C2	R505	B4
C522	B4	R506	C2
C524	A3	R507	C2
C525	C3	R508	A3
C526	B4	R509	A1
C527	B4	T501	C1
C528	C3	T502	B2
C529	A3	T503	B3
C530	A3	Z503	B2
C531	A2	Z504	B2

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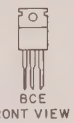
TRANSISTOR DETAILS

TOP VIEW



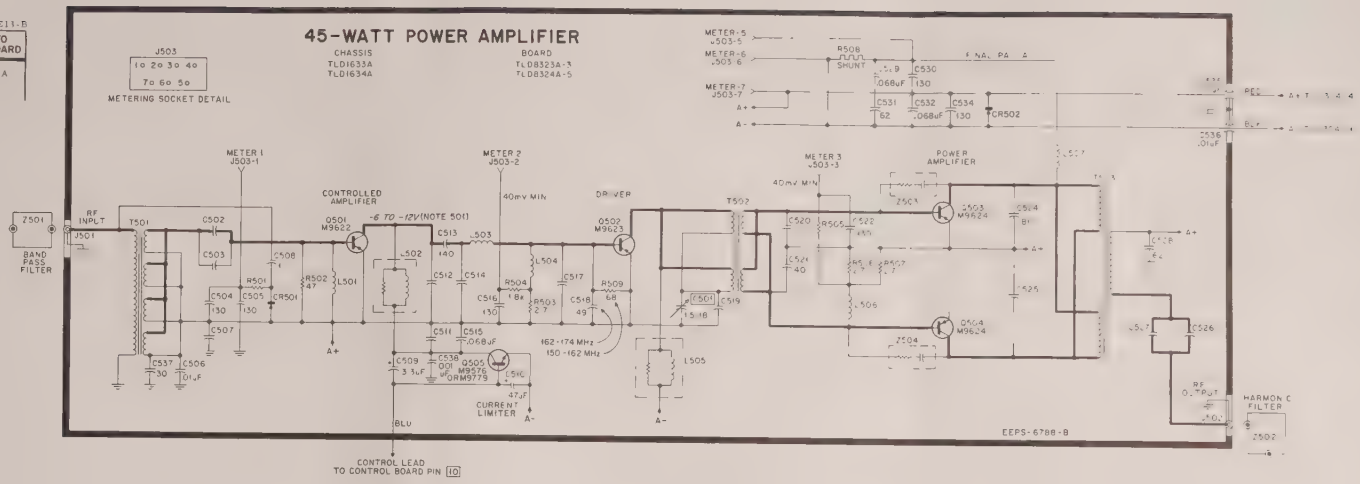
FRONT VIEW

* THESE TRANSISTOR LEADS ARE CONNECTED TO THE COMPONENT SIDE OF THE BOARD ONLY

REVISIONS

63P81013E13-B

CHASSIS AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION	REFER TO CIRCUIT BOARD
TLD1634A (TLD8324A-5)	C538H	ADDED 23-82187E14, .001 uF	Q505 COLLECTOR	PEPS-6822-A



POWER AMPLIFIER

501. VOLTAGES DEPENDENT UPON AMOUNT OF CUTBACK FROM POWER CONTROL BOARD.
502. VOLTAGES MEASURED IN RESPECT TO A+ UNLESS OTHERWISE SPECIFIED.
503. UNLESS OTHERWISE SPECIFIED: CAPACITOR VALUES ARE IN PICOFARADS.
504. FOR COMPONENT VALUES NOT STATED ON THE SCHEMATIC DIAGRAM, REFER TO THE ACCOMPANYING TABLE.

EPS-6783-O

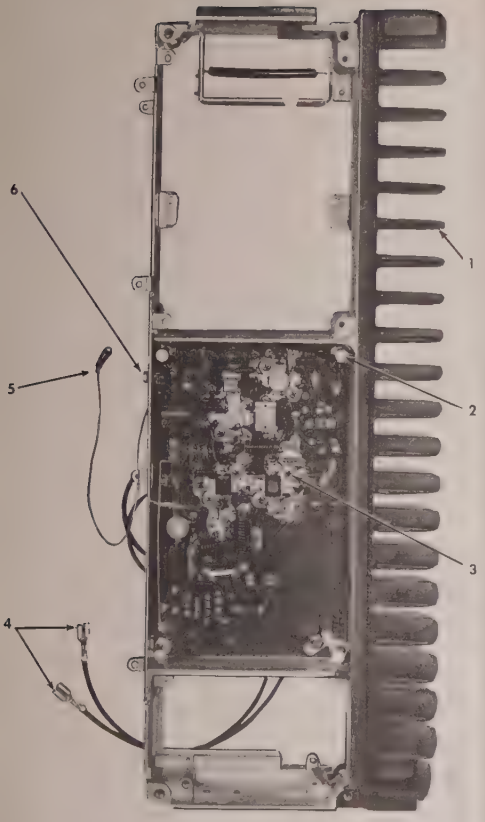
45-WATT POWER AMPLIFIER COMPONENT VALUES

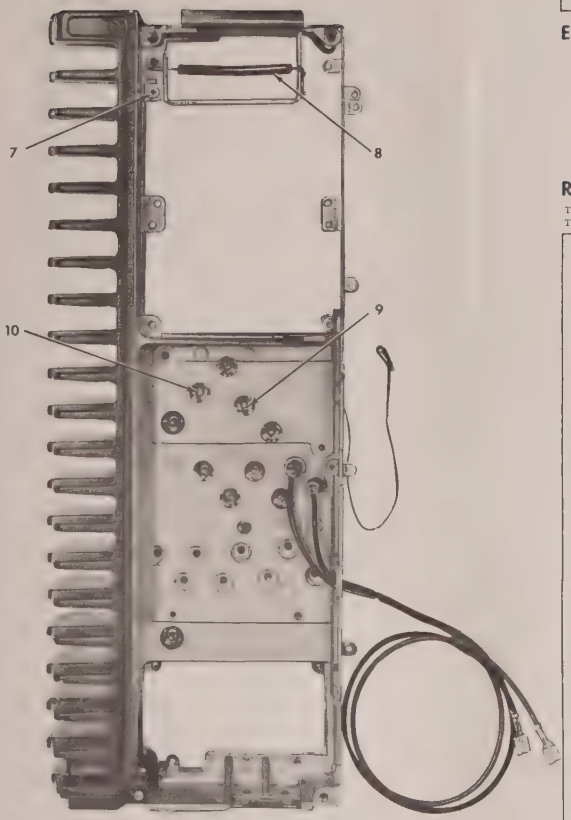
REFERENCE SYMBOL	150.8-162 MHz	162-174 MHz
C502	49	39
C503	51	39
C507	130	OMIT
C511	OMIT	43
C512	10	6
C514	51	39
C517	30	39
C519	20	12
C520	51	75
C525	100	130
C526	OMIT	7
C527	20	7
C538	OMIT	001 uF
R501	68k	82k
R505	3.3k	4.7k

EPS-6776-A

PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

45 Watt Power Amplifier
Schematic Diagram
Motorola No. 63P81013E13-B
7/29/74-NPC





BEPS-6896-O

45 W POWER AMPLIFIER

PARTS LIST

PL-1307-O

CODE	MOTOROLA PART NO.	DESCRIPTION
1	26-84198B01	HEATSINK
2	43-84219C01	SPACER & SCREW; 4 used
3	3-136912	SCREW, machine; No. 4-40 x 1/2"; 8 used
4	39-10184A33	CONNECTOR, receptacle: female; 2 used
5	29-84532B01	LUG, special: 1 used
6	4-84152B01	WASHER, shoulder
7	3-134212	LOCKSCREW; No. 4 x 5/16"
8	41-84144C01	SPRING, retaining
9	2-136912	NUT, square; No. 4-40 x 1/4" 8 used
10	42-10438A01	RETAINER, square nut: 8 used

REFERENCE SYMBOL	MOTOROLA PART NO	DESCRIPTION

ELECTRICAL PARTS LIST

IMPORTANT

USE ONLY THE FOLLOWING MOTOROLA PART NUMBERS WHEN ORDERING REPLACEMENT PARTS

LI [illegible] D
L = 150.8-162 MHz
H = 162-174 MHz

RF POWER AMPLIFIER

TLD1633A (150.8-162 MHz)
TLD1634A (162-174 MHz)

PL-1301-B

		CAPACITOR, fixed: pF, ±[illegible] unless otherwise stated
C501	20-83Z01B07	[illegible] 1, [illegible]-18
C502L	21-84494B02	[illegible]
C502H	21-84494B24	[illegible]
[illegible]	21-84494B01	51
[illegible]	21-84494B24	[illegible]
[illegible]	21-84494B26	130
[illegible]	21-84494B26	130
[illegible]	21-8242RB5[illegible]	.01 uF +80-20%; 200 V
[illegible]	21-84494B26	130
[illegible]		NOT USED
[illegible]	[illegible], 8b4518	1* ±10%
[illegible]	23-83Z14C17	3.3 uF ±20%; 15 [illegible]
[illegible]	23-83Z14C10	47 uF ±20%; 6 V
[illegible]L		NOT USED
[illegible]H	21-84494B28	[illegible]
[illegible]	21-84494B38	15
[illegible]	21-82204B03	b ±0.5 pF; [illegible]
[illegible]	21-84494B04	100
C513H	21-84494B27	140
C514L	21-84494B02	[illegible]
[illegible]H	21-84494B24	[illegible]
[illegible]	8-83813H05	.068 uF ±10%, 100 V
[illegible]	21-84494B26	130
[illegible]	21-84494B33	39
[illegible]H	21-84494B24	39
[illegible]L		USE R509
[illegible]H	21-84494B25	49
[illegible]L	21-84936A03	20
[illegible]H	21-84936A05	12
[illegible]	21-84494B01	51
[illegible]	21-84494B31	[illegible]
[illegible]	21-84494B01	[illegible] V
[illegible]	21-84494B26	130
[illegible]		NOT USED
[illegible]	21-84395B[illegible]	80, 250 V
[illegible]L	21-843[illegible]	100, 250
[illegible]	21-84395B05	130; 250 V
[illegible]L		NOT USED
[illegible]H	21-84936A02	7 ±0.35 pF; 2000 V; P12
[illegible]L	21-84936A03	.0 ±1 pF, 2000 V; P120
[illegible]L	21-84936A02	±0.35 pF; 2000 V; P12
[illegible]	21-84494B02	[illegible]
[illegible]	8-83813H05	.068 uF ±10%; 10
[illegible]	21-84494B26	130
[illegible]	21-84494B02	[illegible]
[illegible]	8-83813H05	.068 uF ±10%, 1
[illegible]		NOT USED
C584	21-84494B26	130
[illegible]	21-84211B01	.01 uF +100-0%, 25
[illegible]	21-84211B01	.01 uF +100-0 [illegible]
C537	21-84494B33	39
C538L		NOT USED
C538H	21-82187E14	.001 uF ±10%, 100 V
		SEMICONDUCTOR DEVICE
CR501	48-82[illegible]4C01	germanium
CR502	48-82[illegible]01	silicon
		CONNECTOR, receptacle
J501	28-84227B01	male; coaxial; miniature type
J502	28-84227B01	male, coaxial; miniature type
J503	[illegible]84207B01	[illegible]-contact
		COIL, RF
L501	24-83961B01	[illegible]e; 3 turns on ferrite core coded BRN
L502L	24-84392B03	b turns over 82-ohm resistor
L502H	24-84392B01	6 turns over 120-ohm resistor
L503L	7-84400B03	choke, consists of [illegible] copper bracket; he[illegible] including mountine tabs

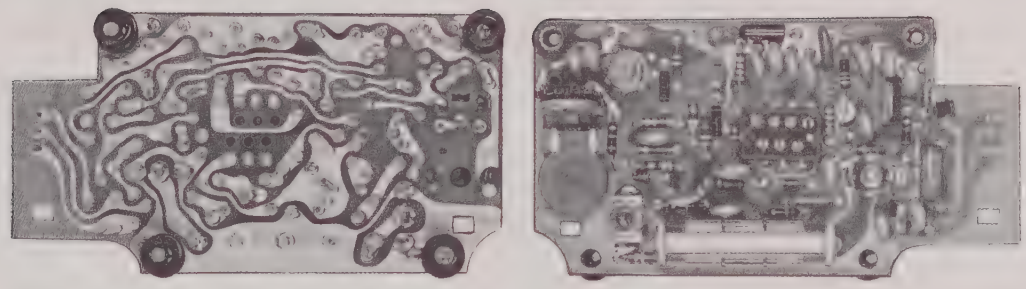
REFERENCE SYMBOL	MOTOROLA PART NO	DESCRIPTION
L503H	7-84400B01	choke; consists of 'U'-shaped copper "bracket"; height 0.137 including mounting[illegible]
L504L	24-83961B03	[illegible] 1 turn on ferrite core coded WHI
L504H	24-83961B01	choke; 3 turns on ferrite core; [illegible]
[illegible]	24-84392B02	[illegible] 9-ohms [illegible]
[illegible]	[illegible]	[illegible] ferrite [illegible]
[illegible]	[illegible]	[illegible] 4-1/2 turns
		TRANSISTOR; (SEE NOTE)
Q501	48-86962Z	[illegible] type M[illegible]
Q502	48-86962	[illegible] M[illegible]
Q503	48-86962[illegible]	[illegible] M[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	OR 48-869779	N-P[illegible], type M9779
		[illegible] ed: ±10°; 1/4 [illegible]
		[illegible]
R501L	6-1[illegible]44	[illegible]
R501H	6-1[illegible]	[illegible]
R502[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
R506	[illegible]	[illegible]
R507	[illegible]	[illegible]
R508	6-84242B0	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
		[illegible]
		[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
		[illegible]
Z501	TFD6112	[illegible]
Z502	TFD[illegible]10	[illegible]
		[illegible] CAPACITANCE
[illegible]	[illegible]	[illegible]
U4	51-84382B01	thick-film type
NON-REFERENCED ITEMS		
	[illegible]	CIRCUIT BOARD ASSEMBL[illegible] 150.8-162
	LDS824A	CIRCUIT BOARD ASSEMBL[illegible] 162-174 MHz
		[illegible]
		The above circuit board as[illegible] [illegible] the follow[illegible] C[illegible], [illegible] 4, 150[illegible] [illegible] thru C50[illegible] Z501, Z502

NOTE:

[illegible] ent diodes and [illegible] part number o[illegible]

POWER CONTROL BOARD

MODEL TLD8290A



TOP VIEW BOTTOM VIEW

AEPS-6127-A

1. DESCRIPTION

The solid-state power control board provides regulation and protection for the rf transistors. The following four functions are provided by the circuitry.

-- Power Leveling - The board permits the adjustment of the output of the power amplifier to the proper level and then maintains that level of output regardless of power or supply voltage fluctuations as long as the gain of the power amplifier is equal to, or above, the preset level.

-- VSWR Protection - A voltage standing wave ratio (VSWR) detector operates during transmitting periods to prevent over-dissipation of the final amplifier transistors should a fault occur in the antenna circuit. The circuitry compares power reflected from the antenna circuit to forward (output) power. When this ratio exceeds a predetermined amount, the output of the circuit lowers the power output of the power amplifier.

-- Temperature Protection - A portion of the circuitry continually monitors heat sink temperature. When a temperature of approximately 80°C is reached, the power control board begins to reduce the power amplifier output to prevent damage to the final stage power transistors. Any further increase in heat sink temperature will cause a correspondingly greater decrease in power output. A reduced power output level will be maintained until the heat sink temperature drops below 80°C.

-- Forward and Reverse Power Metering - Metering points on the board provide a means of monitoring the amount of forward (output) and reflected (reverse) power in the load system.

The power control board is constructed on a single circuit board which is easily removed and replaced. All external connections are made by two coaxial connectors (input and output for the dual directional coupler) and three pins which plug into the control board. All metering points and the single adjustment point are accessible from the plating side of the board.

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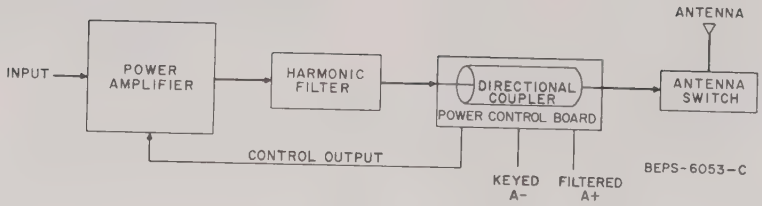


Figure 1.
Loop Block Diagram

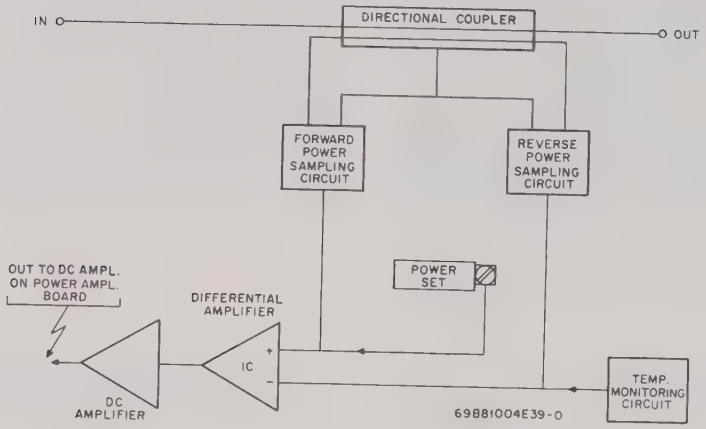


Figure 2.
Power Control Board Block Diagram

2. FUNCTIONAL OPERATION

Refer to the loop block diagram, Figure 1. The circuitry operates as a control loop which continually monitors the output from the final stages of the transmitter power amplifier and controls that output by regulating the gain of the first stage of the power amplifier.

Refer to the block diagram, Figure 2. The output of the integrated circuit differential amplifier, amplified by the dc amplifier, is the controlling input to the power amplifier board.

The output of the differential amplifier is determined by the potentials present on the non-inverting (+) and inverting (-) inputs. These potentials are developed by the power control board circuitry in the following manner.

When the impedances of the antenna circuitry (load) and the power amplifier are matched (a VSWR of 1:1), and the heat sink temperature is below 80°C, a bias voltage produced by the dc reference bias circuitry is placed on the inverting input (also called the "reference input") of the differential amplifier (see Figure 4).

When the transmitter is keyed, the forward (output) power from the final stages of the power amplifier is fed through the directional coupler to the antenna circuit. This flow of power is sampled by the forward power sampling circuitry and places a bias, proportional to the forward power, on the non-inverting input (pin 5) of the differential amplifier. The POWER SET potentiometer is then adjusted, changing the potential on the non-inverting input. As this voltage changes, relative to the reference input voltage, the output of the differential amplifier changes, in turn changing the loop control level and therefore the output of the power amplifier.

Once the power has been set to the proper level, any change in the output power will be instantly corrected by the circuitry. If the power increases, the increase causes the differential amplifier output voltage to increase, decreasing the output from the dc amplifier which decreases the gain of the power amplifier until the output

returns to the preset level. A decrease in transmitter power amplifier output causes the reverse action.

Any power reflected back from the antenna circuit is detected by the reverse power sampling circuit. Reverse power causes a negative current to flow, which, in turn, decreases the potential on the reference input of the differential amplifier. Therefore, increasing levels of reflected power will cause the transmitter power output to be decreased to a safe level.

Temperature increases detected by the temperature monitoring circuit will also decrease the reference level at the inverting input of the differential amplifier, reducing the output power as the heat sink temperature increases above a safe operating point for the power transistors. The higher the temperature, the more the decrease in power out. If the output has been reduced due to temperature, the VSWR circuit becomes more sensitive to reverse power, thus providing further protection for the rf power amplifier transistors.

3. CIRCUIT DESCRIPTION

a. Bias Circuitry

Since the power control board has the capability to regulate the output of the transmitter power amplifier from a completely cut-off state to above the rated output power, a definite controlled output level is necessary whenever the transmitter is keyed. The desired controlled output level is determined by bias voltages present on the inverting and non-inverting inputs of the differential amplifier. Under normal operating conditions (normal heat sink temperature; 1:1 VSWR; 100% rated power out) the bias on the differential amplifier inputs are developed as described in the following paragraphs.

(1) Voltage Regulator and Main Divider Line

Refer to Figure 3. The filtered A+ supply to the board is regulated by a series regulator circuit providing a nominal voltage of 8 volts. The Zener diode holds the base of the series pass transistor at a fixed potential. The series pass transistor operates as a variable resistor to hold the input to the reference circuitry constant. The divider consisting of the two resistors and the diode provides the proper voltage tap points for the secondary voltage divider networks. All 220 pf capacitors in the board are used as rf bypasses.

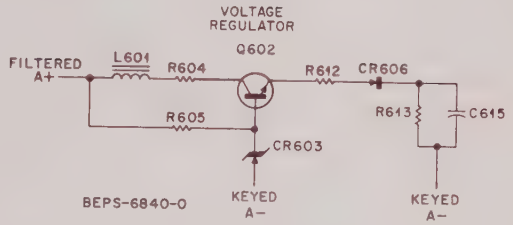


Figure 3.
Voltage Regulator and Main Divider Line

(2) Reference Bias Circuit

Refer to Figure 4. The reference bias is developed (with normal heat sink temperature and a 1:1 VSWR) by the voltage divider made up of two resistors and a diode between the regulated supply voltage and the keyed A- source. Since A+ is applied to the board continuously and A- is only applied when the transmitter is keyed by the push-to-talk switch, the larger capacitor connected between the inverting input and keyed A- provides a time constant which allows the inverting input bias to build up slowly when power is first applied. This prevents full power output from occurring until the leveling circuitry can react and reach a quiescent level.

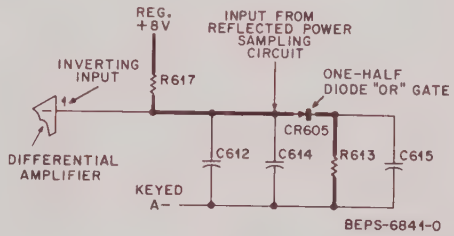


Figure 4.
Reference Power Bias Circuit

b. Directional Coupler

The directional coupler measures the voltage and the current traveling in both directions. The detection of forward (output) power causes a proportional voltage bias that is combined with the voltage-divider generated bias to set the potential on the non-inverting input of the differential amplifier. Any reverse power detected causes the VSWR. circuitry to decrease the power output.

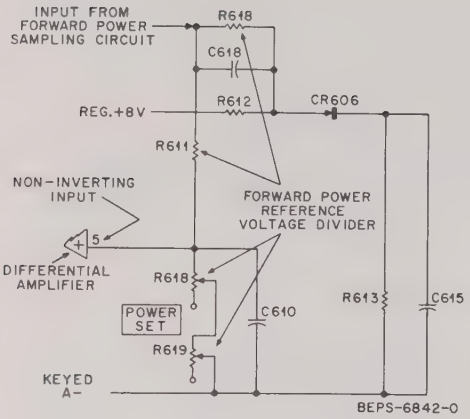


Figure 5.
Forward Power Bias Circuit

c. Protection Circuitry

(1) Forward Power Bias and Detection Circuit

Refer to Figure 5. The forward power reference voltage divider comprised of three resistors and a potentiometer provides a stable potential that supplies a dc bias to the non-inverting input of the differential amplifier. With an approximately correct power output from the final stages of the power amplifier, a dc level proportional to that power is produced by the forward power detector circuit, which, in combination with the voltage developed by the voltage divider, produces a bias on the non-inverting input that can be adjusted by the POWER SET potentiometer. (Refer to the CAUTION preceding the MAINTENANCE section.) The dc bias value will be determined by the power amplifier output and, with no reflected power (VSWR 1:1), balanced against the reference bias present on the inverting input of the differential amplifier. Once the bias has been set, any change in power output will change the bias on the non-inverting input causing the differential amplifier to compensate for the deviation. The forward power detector circuit (refer to Figure 6) detects rf power flowing through the directional coupler when the transmitter is keyed, and causes a small proportional current flow in the forward power sampling circuit. The diode converts the rf sample into a pulsating dc voltage and the dc filter removes the ripple. This is the dc voltage which is added to the dc bias already applied to the non-inverting input of the differential amplifier from the secondary divider circuitry.

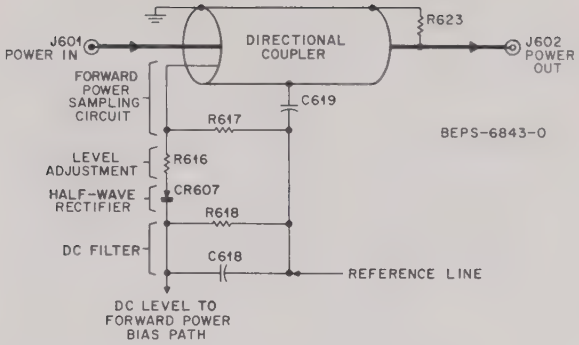


Figure 6.
Forward Power Detector Circuit

(2) VSWR - Reverse Power Detection Circuit

Since the power control board is now operating correctly with the proper amount of forward power and the correct biases, the detection of reflected power causes a decrease in the power amplifier's output in the following manner.

Refer to Figure 7. The components of the reverse power detector circuit function the same as those in the forward power detector. The voltage divider develops a bias voltage that isn't quite enough to forward bias the diode that makes up one-half of a diode "OR" gate. When reflected power is detected, the resultant negative-going dc level lowers the dc bias level and the combination of the two forward bias the diode. The negative-going dc level on the inverting input increases the output voltage of the differential amplifier, decreasing the dc control output to protect the final stages of the power amplifier.

(3) Temperature Protection Circuit

Refer to Figure 8. When the heat sink temperature rises above approximately 80°C, the thermistor in parallel with the lower half of the VSWR voltage divider reaches a value of resistance which allows a more negative potential to be applied through the diode "OR" gate to the inverting input of the differential amplifier. The temperature protection decreases the level of the reference and therefore the power output of the power amplifier board.

(4) DC Level Output Amplification

The output of the differential amplifier is applied to the base of a voltage-inverting

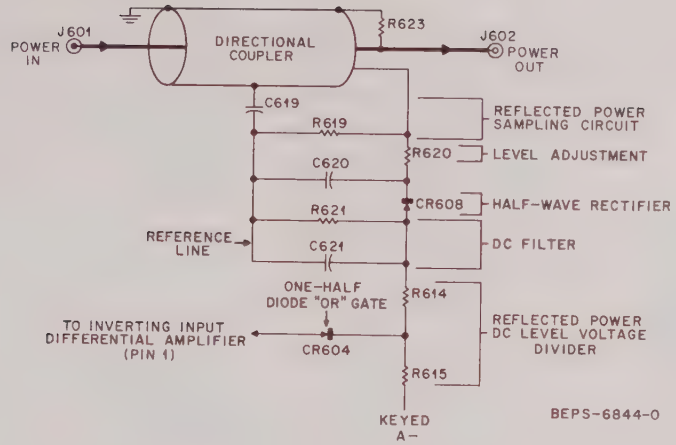


Figure 7.
Reverse Power Detector Circuit

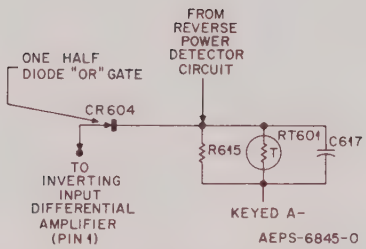


Figure 8.
Temperature Protection Circuit

transistor amplifier whose output supplies the output control current. As the forward power increases above the normal value, the output of the differential amplifier increases proportionally. Since the dc level is increasing the base, the P-N-P transistor conducts less and the potentials across the output load resistor, and on the control output line, decrease.

4. MAINTENANCE

CAUTION

The power control board is incorporated in the transmitter to provide protection for the rf power transistors under environmental conditions such as voltage, temperature, load variation, and device variations. In order for the circuitry to operate properly and provide protection it is necessary to set the power output control (POWER SET) in accordance with the radio set tune-up procedure.

a. General

Three basic maintenance approaches may be used for localizing and repairing trouble in these radio sets.

- Replace the entire radio set with a spare and return the defective radio set to a maintenance shop for repair. The approach is well suited fo fleet users with several identical radios.

- Replace the defective circuit board with a spare and return the defective board to a maintenance shop for repair. This approach is recommended for maintenance facilities that maintain several similar radio sets.

- Isolate and repair the trouble on the spot. This approach must be used if spares are not available.

Regardless of the maintenance approach used, a few simple tests on the overall radio set will localize the trouble to the power control board if it is defective. These procedures are given elsewhere in the manual. This section of the manual provides the maintenance shop level procedures for the power control circuitry. It assumes that preliminary tests have already localized the trouble to the power control board. These bench test type procedures include measurements with a Motorola portable test set, a simple set of performance tests, and complete troubleshooting procedures including step-by-step circuit check-out.

NOTE

The power control board must be installed in a radio set for testing to provide the necessary power, ground, control, and signal connections. For bench testing of a board that has been removed from the radio set and replaced by a spare, another radio set, complete with control head and cable, is required as a test fixture for troubleshooting.

b. Recommended Test Equipment

The following test equipment is the minimum required for troubleshooting and adjusting the board. All such equipment is battery operated which permits testing to be performed in the field where no commercial power is available for bench type test equipment. When ac operated equipment is used, the ground lead must not be electrically connected to ac line ground.

(1) Motorola S1056A through S1059A Portable Test Set and Model TEK-37A Adapter Cable. (The portable test set is necessary to monitor forward and reverse power detectors.)

(2) Motorola Solid-State DC Multimeter S1052B/S1063A or equivalent. A 20,000 ohm-per-volt multimeter may be used but a low impedance volt-ohm meter may not be used. This meter is used for measuring dc voltages and resistance.

(3) Motorola T1013A RF Load Resistor (Dummy Load) or equivalent.

CAUTION

Care must be exercised if the radio is to be bench tested by the application of 12-volts directly to the radio transmitter and/or receiver stages. The power supply deck provides overvoltage and surge protection for these circuits; hence, an external power supply feeding the rf circuits directly must be well enough regulated to provide supply voltages that remain below harmful levels. Such a supply must provide a terminal voltage of 13.4 volts under full load with the transmitter keyed, but not exceed 16.5 volts (including transients) when switched to the no load (unkeyed) condition. Most power supplies will not meet this requirement; in fact, some SCR regulated power supplies have transient response that allows the output voltage to momentarily triple when switched from full load to no load. The following bench supplies are approved for testing the "Micor" radio when the power supply deck is bypassed:

Motorola S1303A or S1305A Regulated Power Supply.

Motorola T1261A Transistorized 24-Volt to 12-volt Converter driven by a Motorola T1012A Power Supply.

12-Volt automotive battery with a Motorola T1012A Power Supply used as a battery charger.

c. Test Set Metering

The power control board is equipped with a metering receptacle which allows three major test points (forward power, reflected power and control current) to be measured on a Motorola portable test set. The portable test set may be connected to the power control board metering receptacle and readings made at each of the test points by merely rotating a selector switch and the meter reversing switch on the test set. Refer to the troubleshooting charts or the schematic diagram for the correct meter indications.

To make the measurements, the portable test set must be connected to the radio set as shown in Figure 9., and listed in the following procedure.

(1) Set the function selector switch of the portable test set to the XMTR position.

(2) Set the meter reversing switch of the test set to the METER REV position.

(3) Set the SENS switch on the test set adapter to the 100 mV position and the REF switch to position A or B (later models of the test set adapter do not have a SENS switch).

(4) Connect the 20-pin meter cable plug to the test set. When the test set is not in use, disconnect the 20-pin plug to conserve battery life. The plug acts as an on-off switch completing the battery circuit.

(5) Connect the red "control" plug of the adapter cable to the receptacle on the control circuit board of the radio set. Connect the white "metering" plug of the adapter cable to the receptacle on the power control board.

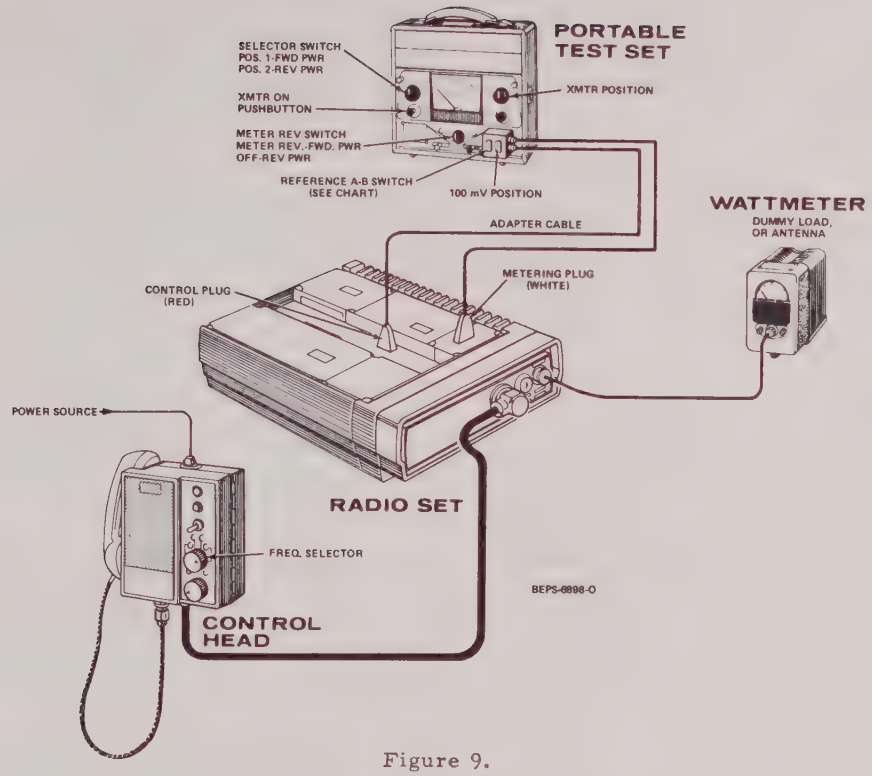


Figure 9.
Power Control Board Metering Test Set-Up

(6) The output of the power control board must be terminated in one of three types of loads.

-- The antenna load.

-- A dummy load such as Motorola's T1013A RF Load Resistor.

-- An RF wattmeter.

NOTE

A dummy load is preferred to the antenna to eliminate the possibility of shutback due to a defective antenna.

(7) Connect power to the radio set.

(8) Set the selector switch of the test set to position 1 and key the transmitter with the XMTR ON button on the test set. Observe the wattmeter, or the meter reading if a dummy load is used or if the antenna is used. Unkey the transmitter. Under normal conditions at rated power out, meter 1 should read between 22 uA and 40 uA typically.

d. Performance Tests

(1) POWER SET Control

This control allows the power output of the radio set to be varied from zero (0) power out with the control fully counterclockwise to greater than the rated output.

CAUTION

For proper operation of the protection circuitry, it is imperative that the POWER SET control never be left in a position that exceeds rated power output.

Refer to the power amplifier tune-up procedure.

(a) Key the transmitter.

(b) Adjust the POWER SET control until the rated power output is reached.

(c) Unkey the transmitter.

(2) Automatic Leveling Control

If a power supply is used, set the power output to the rated output with the power supply voltage at +13.6 volts.

(a) Key the transmitter.

(b) Vary the supply voltage from +13.6 volts to +16 volts, there should be less than +10% change in the power output.

(c) Return the supply to +13.6 volts and unkey the transmitter.

e. Troubleshooting

(1) Isolating Defective Components

If test set readings are abnormal or tests indicate subnormal performance, a logical troubleshooting procedure is required to isolate the defective component efficiently. The accompanying troubleshooting charts summarize these results in a logical sequence. A few voltage and resistance checks in the suspected circuit should readily isolate the defective component.

(2) Troubleshooting Integrated Circuits

Integrated circuits (IC's) are very reliable components and should not be replaced until all checks have proven definitely that the IC is the defective component. Removal of an IC is time consuming and often ruins the part. Therefore, a few extra checks before that task is attempted are worthwhile. Before replacing a bad IC, make sure that the external components in the circuit are normal. Otherwise, the conditions which caused the IC to fail initially may still be present and destroy the new IC.

A defective IC on the power control board may be located by dc voltage measurements. Measure the dc voltages at the pins of the IC, as shown in the troubleshooting charts. Refer to the troubleshooting charts to locate and isolate any defective component on the board.

If the IC is to be replaced, use a "desoldering" iron with a vacuum bulb to remove solder.

f. Troubleshooting Notes

The schematic diagram of the power control board contains the voltages necessary for troubleshooting. These voltages are typical for normal operating conditions at rated power out for the radio. Refer to the troubleshooting charts and the schematic when troubleshooting and a defect is suspected on the power control board.

NOTES

(1) Slight variations in meter readings or power out may occur during measurements. This is normal and does not necessarily indicate any problem.

(2) With 0 reflected power (1:1 VSWR) meter 2 will read between -10 uA and -18 uA. Again, this is normal and does not indicate a defect. The meter reversing switch must be placed in the OFF position for upscale readings of meter 2.

g. Complete Power Amplifier Alignment

A complete realignment of the power amplifier tuning controls and power control board adjustments may be necessary under the following conditions:

(1) Major changes, repairs (such as transistor replacement) or complete replacement of the power amplifier board.

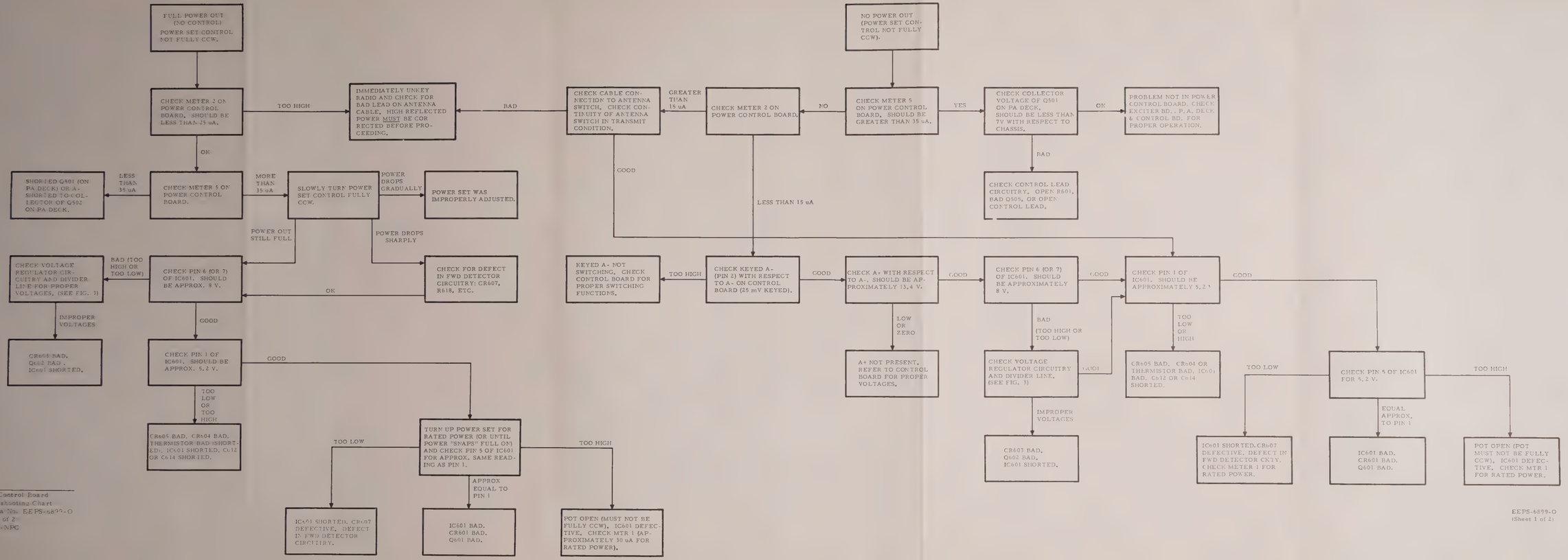
(2) Repair or replacement of the power control board.

(3) A change in transmitter frequency greater than approximately ±1 MHz.

A complete alignment procedure is at the end of this section.

IMPORTANT

The complete alignment procedure differs from the standard tune-up procedure in that a factory set control which has been adjusted for full power amplifier protection under tune-up conditions must be readjusted. This complete alignment procedure is not required and should not be performed when an alignment check is required or if frequency has been changed less than ±1 MHz.



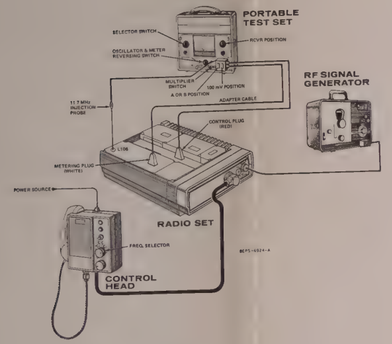
Power Control Board
Troubleshooting Chart
Motorola No. EEPS-6899-O
Sheet 1 of 2
7/29-74-NPC

12-10

EEPS-6899-O
(Sheet 1 of 2)

RECEIVER ALIGNMENT PROCEDURE

A. TEST EQUIPMENT SET-UP



B. FREQUENCY CALCULATIONS

Where:

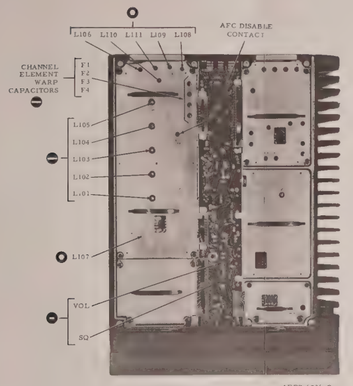
f_o - channel element frequency

f_c - carrier frequency

150.8-174 MHz

$$f_o = \frac{f_c - 11.7\ \text{MHz}}{9}$$

C. RECEIVER ADJUSTMENT LOCATIONS



D. TYPICAL RECEIVER METER READINGS

(NO INPUT SIGNAL APPLIED)

TEST SET SELECTOR SWITCH POSITION	READING (uA)	CIRCUIT METERED
3	15	Channel Element Output
4	0 ±2	Discriminator Output
5	1 or less (if unreadable, inject maximum on-channel signal at antenna receptacle; 20 uA, typical, should be obtained).	3rd IF Amplifier and Limiter

E. RECEIVER ALIGNMENT

STEP	ADJUST	SELECTOR SWITCH POSITION	OSC & METER REV. SWITCH	STAGE AND PROCEDURE
1	L108, L109	3	METER REV.	CHANNEL ELEMENT OUTPUT (3RD HARMONIC) - Adjust L108 and L109 for maximum test set meter indication. On multi-frequency radios make this adjustment with frequency selector switch in F1 position.
2	L107	11 4	A or B (Test Set must be equipped with 11.7 MHz crystal in corresponding socket).	DISCRIMINATOR - Unsquelch the radio set by turning the squelch control on the control board fully counterclockwise. "Private-Line" radios must also be PL disabled by placing the PL monitor switch on the control head in the OFF position. Note test set meter indication in position 11 (multiplier switch in 2 V AC position). Insert 11.7 MHz injection probe of test set into L106 opening of receiver shield being careful not to contact circuit board. Insert probe into hole far enough to obtain reading 1/10 of that noted at beginning of this step (signal is "sprayed" into radio). Adjust L107 for 0 center reading on top scale with selector switch of test set in position 4. Adjustment is critical and should be exactly on 0. Remove probe.
3	L110, L111	5	METER REV.	MULTIPLIER - Connect signal generator to antenna input and apply a carrier frequency signal. Adjust L110 and L111 for maximum meter indication. If two peaks are observed, use peak with slugs farthest from circuit board. If a meter 5 indication cannot be obtained, connect center conductor of signal generator cable directly to the mixer gate.
4	L101, L102, L103, L104, L105, L106	5	METER REV.	RF PRESELECTOR AND MIXER - Turn out L101 thru L105 slugs until tip of each tuning screw extends approx. 1/4 inch beyond spring (parts list code 8). Connect signal generator to antenna input and apply carrier frequency signal. Tune L101 thru L105 for peak on meter position 5. Turn L103, L104, and L105 slugs in one turn. Peak L106 thru L101, in that order, on meter position 5. Decrease signal generator output as necessary to maintain indication between 10 and 25 uA.
5	L108, L110, L111	5	METER REV.	Adjust signal generator output for 25 uA meter indication. Detune L108 until meter indication decreases to 15 uA. Repeak L110 and L111 for maximum meter indication. Repeat entire step.
6	L108, L109	3	METER REV.	Repeak L108 and L109 for maximum meter indication.
7	L101, L102, L103, L104, L105	5 11	METER REV. OFF	Repeak L101 through L105 for maximum meter indication. Repeat. Peak L103 thru L105 for minimum indication on meter 11 (maximum quieting).
8	F1, F2, F3, F4	5	METER REV.	ON-FREQUENCY ADJUSTMENT - Disconnect signal generator and transmit carrier signal from transmitter normally received. If transmitter is known to be on frequency, test set meter position 5 should indicate rise when transmitter is keyed (if necessary connect antenna).

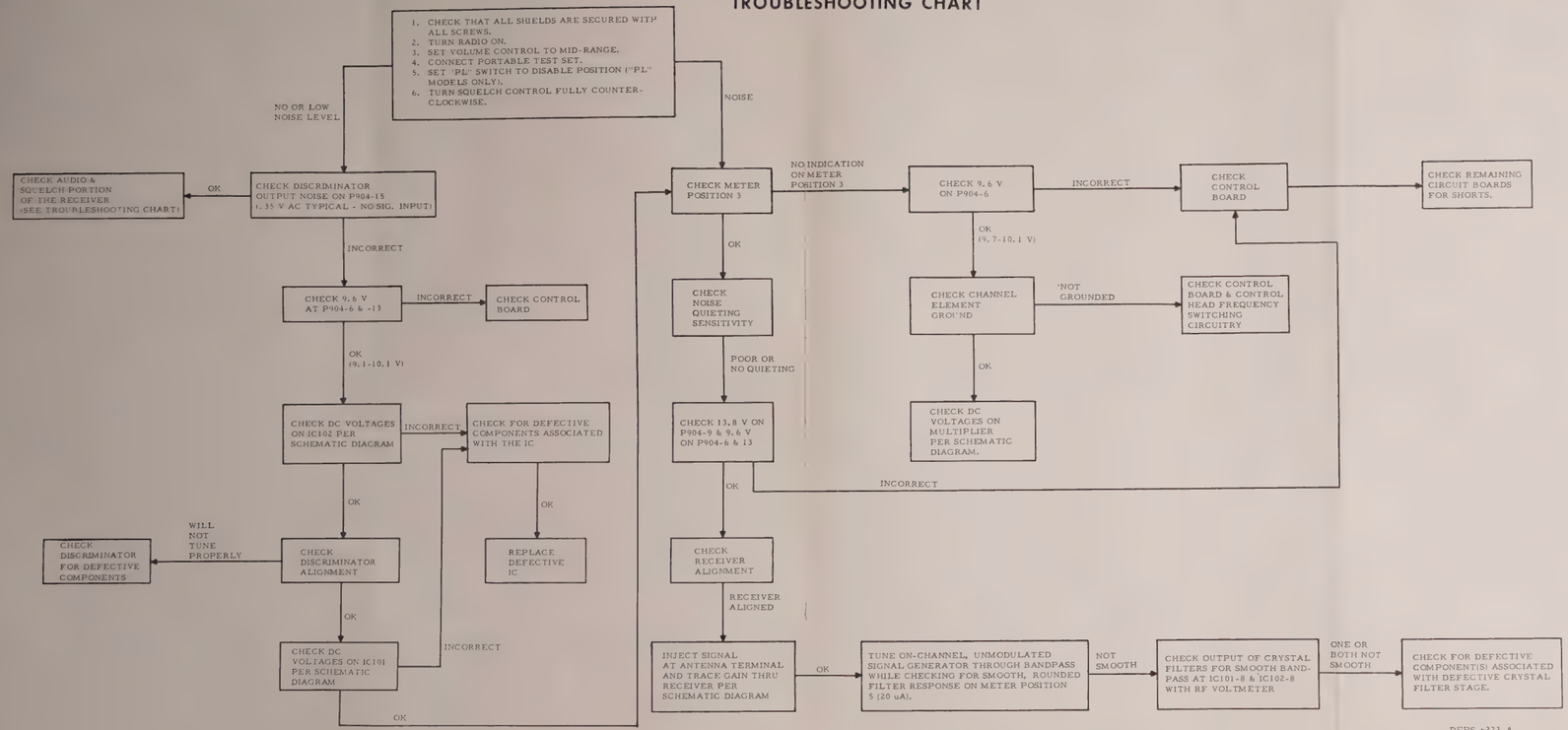
E. RECEIVER ALIGNMENT (Cont'd)

STEP	ADJUST	SELECTOR SWITCH POSITION	OSC & METER REV. SWITCH	STAGE AND PROCEDURE
8 Cont'd		4		Check test set position 4 reading with transmitter keyed. 0 indicates on-frequency condition. Adjust F1, F2, F3 and F4 receiver warp capacitors for exact 0 reading in corresponding frequency selector switch positions. DO NOT READJUST L108 OR L109 AFTER THESE ADJUSTMENTS ARE MADE. If radio is equipped with AFC, short the AFC DISABLE contact while adjusting F1, F2, F3 and F4.
9	-	-	-	Perform 20 dB quieting sensitivity measurement as check of alignment.

F. RF PREAMPLIFIER ALIGNMENT

STEP	ADJUST	SELECTOR SWITCH POSITION	OSC & METER REV. SWITCH	PROCEDURE
1				If radio is equipped with optional preamplifier, disconnect and bypass the preamplifier. Align the receiver then reconnect the preamplifier.
2	L3, L2, L1		METER REV.	Adjust L3, L2, and L1 in that order for maximum test set meter indication. Repeat.
3				Tune L2 for maximum quieting.

RECEIVER RF & IF CIRCUIT BOARD TROUBLESHOOTING CHART



DEPS-6223-A

DC VOLTAGE TABLE FOR IC'S

IC101		IC102	
PIN	VOLTAGE	PIN	VOLTAGE
1	2.8 V	1	2.9 V
5	9.3 V	2	0 V
6	7.2 V	3	2.9 V
7	6.4 V	4	6 V
8	2.8 V	5	9.1 V
9	2.8 V	6	7.2 V
10	0 V	7	6.4 V
		8	2.9 V
		9	2.9 V
		10	0 V

EPS-6380-A

RECEIVER RF & IF BOARD

101. RECEIVER FREQUENCY CALCULATION:

$f_c = 9f_o + 11.7$ MHz $f_o = \frac{f_c - 11.7 \text{ MHz}}{9}$

WHERE f_c = CARRIER FREQUENCY

f_o = CHANNEL ELEMENT FREQUENCY

102. DASHED LINES REPRESENT SHIELDING.
103. INDEX DOT ON Y106 CRYSTAL CAN INDICATES PHYSICAL ORIENTATION REQUIRED.
104. RF VOLTAGES TAKEN WITH MOTOROLA SOLID-STATE DC MULTIMETER WITH PLUG-IN RF PROBE.
105. UNLESS OTHERWISE STATED:
CAPACITOR VALUES ARE IN PICOFARADS.
106. UNLESS OTHERWISE STATED, VOLTAGE MEASUREMENTS ARE FOR DC VOLTAGES MEASURED WITH AN 11 MEGOHM INPUT RESISTANCE VOLTMETER IN RESPECT TO CHASSIS GROUND.

EPS-6784-O

RECEIVER RF VOLTAGE TABLE

SET RF INPUT AT ANT. TO OBTAIN (NOTE 104)	AT TEST POINT	RF INPUT SHOULD BE (MAY VARY APPROX. 2 TO 1)
300 mV	(A)	13 mV
	(B)	13 mV
	(C)	8 mV
	(D)	3 mV
	(E)	4 mV
	(F)	5 mV
	(G)	5 mV
	(H)	13 mV
50 mV	(I)	50 uV
	(J)	10 uV
	(K)	14 uV
	(L)	20 uV
	(M)	21 uV
	(N)	72 uV

EPS-6785-A

RECEIVER BOARD & RF DECK COMPONENT VALUES

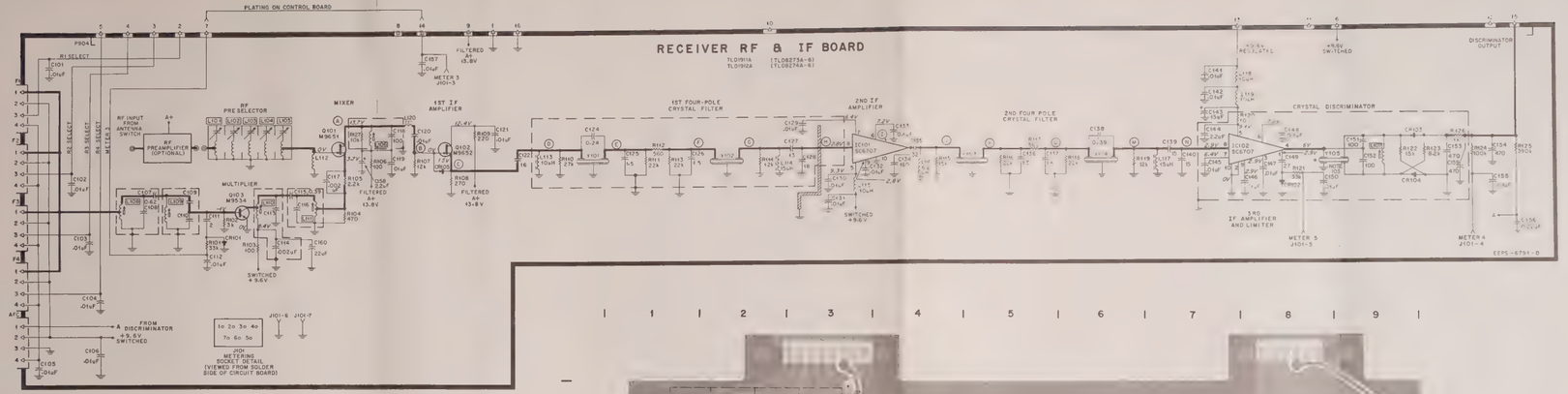
REFERENCE SYMBOL	150.8-162 MHz	162 174 MHz
C108	30	27
C109	47	39
C110	120	100
C113	10	7.5
C116	10	7.5

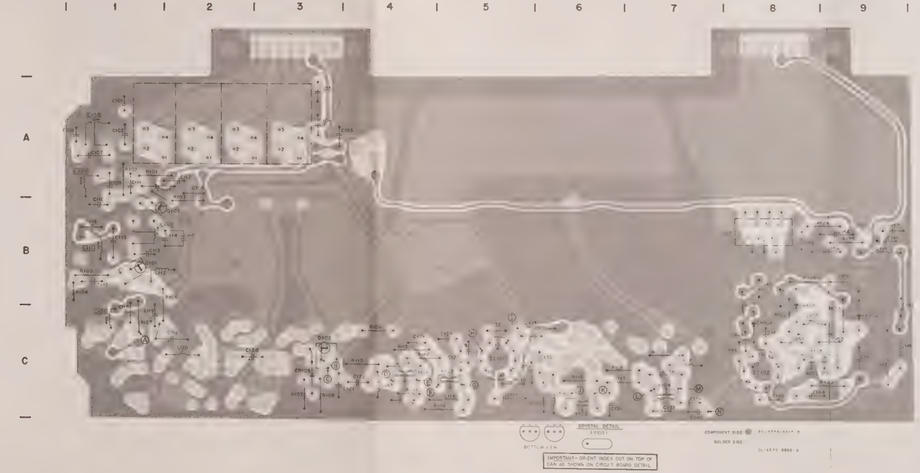
EPS-6786-O

RECEIVER RF & IF BOARD COMPONENT LOCATIONS

REF. SYM.	LOCATION
C101	A1
C102	A1
C103	A3
C104	A3
C105	A3
C106	A2
C107	A1
C108	A1
C109	A1
C110	B1
C111	A1
C112	A2
C113	B1
C114	B2
C115	B1
C116	B1
C117	B1
C118	C1
C119	C1
C120	C2
C121	C3
C122	C4
C124	C4
C125	C4
C126	C4
C127	C5
C128	C5
C129	C5
C130	C5
C131	C6
C132	C5
C133	C5
C134	C5
C135	C6
C136	C6
C137	C7
C138	C7
C139	C7
C140	C7
C141	B9
C142	B9
C143	C9
C144	C8
C145	C8
C146	C8
C147	C8
C148	C9
C149	C8
C150	B8
C151	C8
C152	C9
C153	B8
C154	B9
C155	B8
C156	B9
C157	B9
C158	C2
C159	B9
C160	B2
CR101	A2
CR102	C8
CR103	B8
CR104	C9
CR105	C3
IC101	C5
IC102	C8
L106	C1
L107	C8
L108	A1
L109	A1
L110	B1
L111	B1
L112	B2
L113	C4
L114	C5
L115	C5
L116	C6
L117	C7
L118	B9
L119	C9
L120	C2
Q101	B1
Q102	C3
Q103	B2
R101	A1
R102	A1
R103	B2
R104	B1
R105	B1
R106	B2
R107	C3
R108	C3
R109	C4
R110	C4
R111	C4
R112	C4
R113	C4
R114	C5
R115	C6
R116	C6
R117	C6
R118	C6
R119	C7
R120	C9
R121	B8
R122	C8
R123	C9
R124	B9
R125	B9
R126	B8
R127	C1
Y101	C4
Y102	C5
Y103	C6
Y104	C7
Y105	C8

EPS-6930-B





PREVIOUS REVISIONS AND PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

TLD8270A Series Receiver RF & IF Board
Schematic Diagram and Circuit Board Detail
Motorola No. 63P81013E19-D
7/29/74-NPC

REVISIONS

CHASSIS AND SUFFIX NO.	REF SYMBOL	CHANGE	LOCATION
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]		[illegible]	PARTS LIST [illegible] DIAGRAM
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	[illegible]	[illegible]	DISCRIMINATOR [illegible]
	[illegible]	[illegible]	PARTS LIST
[illegible]		[illegible]	SCHEMATIC & PARTS LIST
[illegible]		[illegible]	PARTS LIST

RECEIVER RF & IF BOARD

TLD8270A Series Receiver RF & IF Board
Mechanical and Electrical Parts List
Motorola No. PEPS-6929-C
7/29/74-NPC

21-14

ELECTRICAL PARTS LIST

IMPORTANT

USE ONLY THE FOLLOWING MOTOROLA PART NUMBERS WHEN ORDERING REPLACEMENT PARTS

LEGEND

L = 150.8-162 MHz   H = 162-174 MHz

TLD8274A Receiver Board & RF Deck (150.8-162 MHz
RF TLD1411A
TLD8274A Receiver Board & RF Deck 162-174 MHz
RF TLD1412A

PL-1511-C

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed: pF, ±5%, 500 V: unl stated
C101 thru 106	21-82428B59	.01 uF +80-20%, 200 V
C107	21-82450B[illegible]	0.62
C108L	21-82610C44	36, 200 V, NP0
C108H	21-82133G[illegible]	27, NP0
C109L	21-83406D44	47, NP0
C109H	21-82610C44	39, 450 V, NP0
C110L	21-84434B[illegible]	12
C110H	21-83784B01	100
C111	21-82133G37	2 ±0.25 pF, NP0
C112	21-82428B59	.01 uF +80-20%, 200 V
C113L	21-83406D36	10 ±0.25 pF, NP0
C113H	21-82133G14	7.5 ±0.25 pF, NP0
C114	21-83596E14	.002 uF ±10%, 200 V, Y5F
C115	21-82450B07	0.33
C116L	21-83406D36	10 ±0.25 pF, NP0
C116H	21-82133G14	7.5 ±0.25 pF, NP0
C117	21-83596E14	.002 uF ±10%; 200 V; Y5F
C118	21-82610C44	100; 100 V; N220
C119	21-82428B59	.01 uF +80-20%, 200 V
C120	21-82428B59	.01 uF +80-20%, 200 V
C121	21-82428B59	.01 uF +80-20%, 200 V
C122	21-82133G49	16, NP0
C123		NOT USED
C124	21-82450B05	0.24
C125	21-868487	1.5 ±0.25 pF; NP0
C126	21-868487	1.5 ±0.25 pF; NP0
C127	21-83406D57	13, NP0
C128	21-83406D55	18, NP0
C129	21-82428B59	.01 uF +80-20%, 200 V
C130	21-82428B59	.01 uF +80-20%, 200 V
C131	21-82428B59	.01 uF +80-20%, 200 V
C132	21-82428B59	.01 uF +80-20%, 200 V
C133	8-83813H16	0.1 uF ±10%
C134	21-84534B05	160
C135	21-83406D39	32, NP0
C136	21-868487	1.5 ±0.25 pF; NP0
C137	21-868487	1.5 ±0.25 pF; NP0
C138	21-82450B07	0.33
C139	21-82133G19	15, NP0
C140	21-82133G19	15, NP0
C141	21-82428B59	.01 uF +80-20%; 200 V
C142	21-82428B59	.01 uF +80-20%; 200 V
C143	23-83214C02	15 uF ±20%, 25 V
C144	23-84762H04	2.2 uF ±20%; 25 V
C145	21-82428B59	.01 uF +80-20%, 200 V
C146	21-82428B59	.01 uF +80-20%; 200 V
C147	21-82428B59	.01 uF +80-20%; 200 V
C148	21-82428B59	.01 uF ±10%
C149	21-82133G58	27, NP0
C150	21-82428B59	.01 uF +80-20%, 200 V
C151	21-83798B01	100, 200 V, NP0
C152	21-83798B01	100, 200 V, NP0
C153	21-82187B39	470 ±10%
C154	21-82187B39	470 ±10%
C155	21-82428B59	.01 uF +80-20%, 200 V
C156	8-83813H11	0.22 uF ±10%, 75 V
C157	21-82428B59	.01 uF +80-20%, 200 V
C158	23-84762H04	2.2 uF ±20%, 25 V
C159	21-82187B07	470 ±10%
		SEMICONDUCTOR DEVICE, diode: SEE NOTE)
CR101	48-82139G01	germanium
CR102	48-82139G01	germanium
CR103	48-84616A01	planar hot carrier
CR104	48-84616A01	planar hot carrier
CR105	48-84616A01	planar hot carrier
		INTEGRATED CIRCUIT:
IC101	51-84267A07	SC6707
IC102	51-84267A07	SC6707
		CONNECTOR, receptacle:
J101	9-84207B01	female; 7 contact
J102	9-84135B01	female; single contact; phono type
		COIL, RF: unl stated
L101L	24-84409B01	input
L101H	24-84409B01	input
L102L	24-84409B03	center
L102H	24-84409B03	center
L103L	24-84409B03	center
L103H	24-84409B03	center
L104L	24-84409B03	center
L104H	24-84409B03	center
L105L	1V80709B36	output
L105H	1V80709B36	output
L106	24-83879G08	IF (GRN)
L107	24-84258B04	discriminator (YEL)
L108	24-84115B11	multiplier (BRN)
L109	24-84115B12	multiplier (RED)
L110	24-83857G07	multiplier (YEL)
L111	24-83857G08	multiplier (VIO)
L112L	24-84411B02	choke, YEL
L112H	24-84411B01	choke, WHT
L113	24-82549D25	choke, 10 uH (shielded)
L114	24-82549D24	choke, 15 uF (shielded)
L115	24-82723H07	choke; 10 uH (VIO)
L116	24-82723H06	choke; 6.2 uH (BLU)
L117	24-82549D24	choke; 15 uH (shielded)
L118	24-82723H07	choke; 10 uH (VIO)
L119	24-82723H07	choke, 10 uH (VIO)
L120	76-83960B01	choke; ferrite bead
		TRANSISTOR: (SEE NOTE)
Q101	48-869651	N-Channel; FET M9651
Q102	48-869652	N-Channel; FET M9652
Q103	48-869534	N-P-N; M9534
		RESISTOR, fixed: ±10%; 1/4 W; unl stated
R101	6-127807	33k
R102	6-124A60	3k ±5%
R103	6-129753	100
R104	6-127801	470
R105	6-128689	2.2k
R106	6-129753	100
R107	6-129230	12k
R108	6-129752	270
R109	6-127800	220
R110	6-129886	27k ±5%
R111	6-129667	22k ±5%
R112	6-129779	560 ±5%
R113	6-129667	22k ±5%
R114	6-129887	12k ±5%
R115	6-129236	15k ±5%
R116	6-129667	22k ±5%
R117	6-129779	560 ±5%
R118	6-129667	22k ±5%
R119	6-129887	12k ±5%
R120	6-129755	10
R121	6-127807	33k
R122	6-129236	15k ±5%
R123	6-129983	8.2k ±5%
R124	6-129226	100k
R125	6-128682	390k
R126	6-127805	1k
R127	6-129225	10k
		CRYSTAL, quartz:
Y101 thru 104	48-84412B01	11.700 kHz
Y105	48-84669B01	11.700 kHz

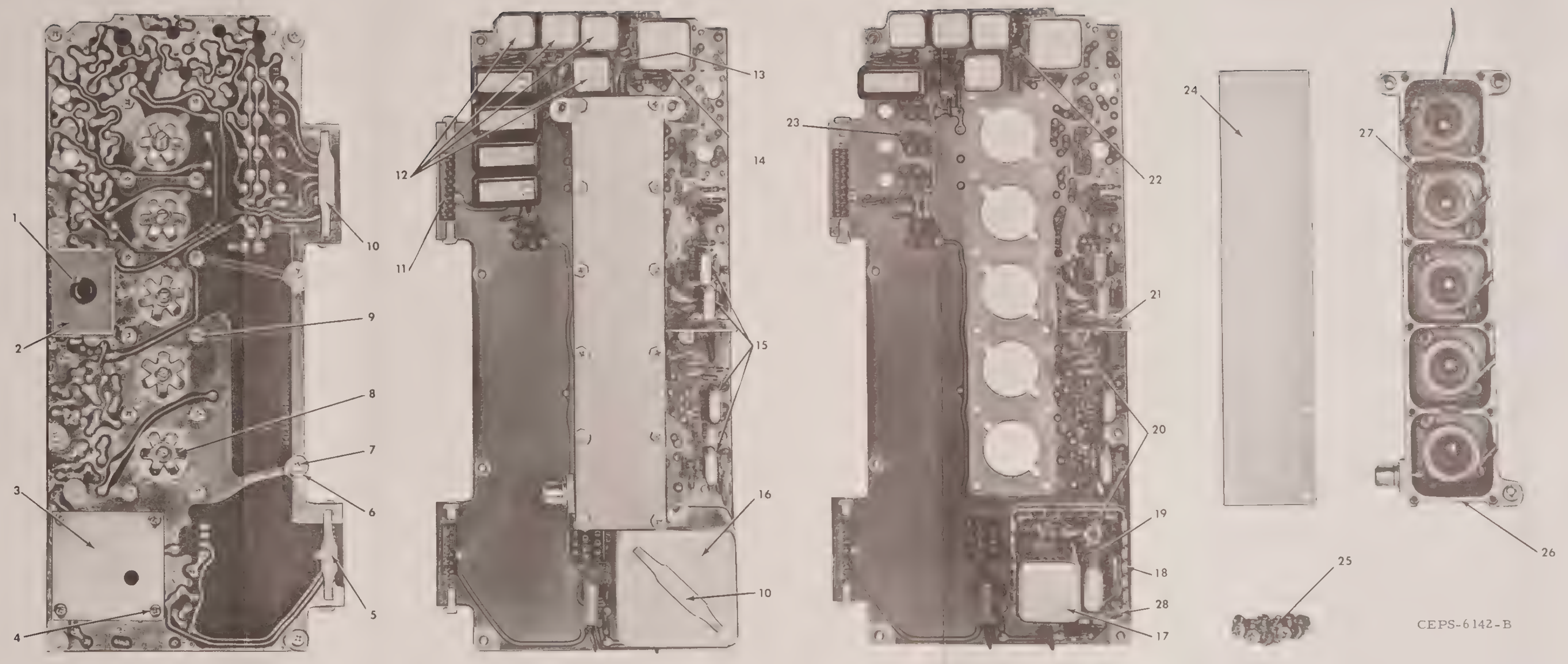
PARTS LIST

Mechanical Parts List   PL-872-C

CODE	MOTOROLA PART NO.	DESCRIPTION
1	5B84644B01	GROMMET, rubber
2	26C84642B01	SHIELD (IF)
3	26B84413B01	SHIELD (discriminator)
4	3S138398	SCREW, tapping: 4-24 x 1/2" (4 req'd)
5	55B84300B02	HANDLE (short)
6	42C84284B01	RETAINER, screw: 9 req'd
7	3S136905	LOCKSCREW: No. 4 x 5/16"; 9 req'd
8	41B84410B01	SPRING, torque: 5 req'd
9	3S135084	LOCKSCREW: No. 4 x 5/16"; 12 req'd
10	55B84300B01	HANDLE (long); 2 req'd
11	29C84028H01	CONTACT, male: 16 req'd
12	26B84250B05	SHIELD, 4 req'd
13	39S10184A24	CONTACT, female
14	26B84250B06	SHIELD
15	14B84540B01	INSULATOR (crystal) 4 req'd
16	26B84414B01	SHIELD, bottom
17	26B84250B07	SHIELD
18	26C84415B01	SHIELD, spring
19	14A84583B01	INSULATOR (crystal)
20	4A49854	WASHER, spacer: 2 req'd
21	26B84643B01	SHIELD, barrier
22	39S10184A30	CONTACT
23	29K855943	CONTACT, male; 20 req'd
24	15D84408B01	COVER, RF deck
25	3S134169	LOCKSCREW: No. 4 x 1/4" 12 req'd
26	15D84407B01	HOUSING, RF deck
27	3S136926	LOCKSCREW: No. 4-40 x 5/16" 10 req'd.
28	5B84220B01	GROMMET, "Nylon"; 4 req'd

NOTE:

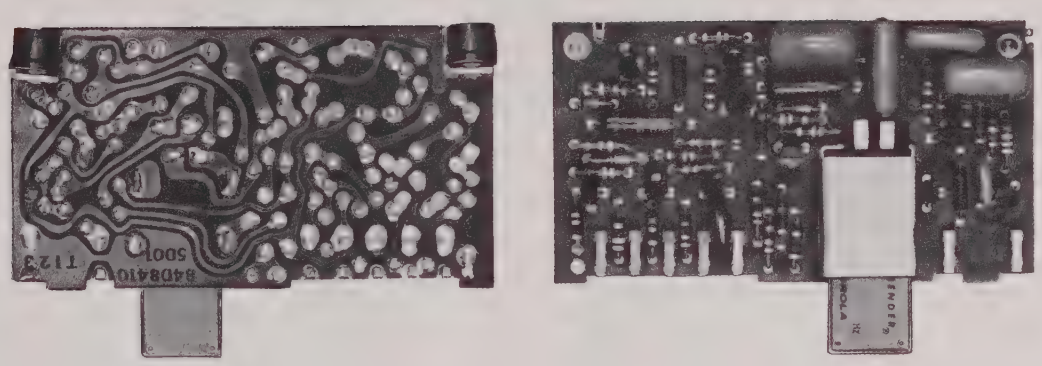
Replacement diodes and transistors must be ordered by Motorola part number only for optimum performance.



CEPS-6142-B

"PRIVATE-LINE" ENCODER

MODEL TLN4293B



AEPS 6936-O

TECHNICAL CHARACTERISTICS

"PL" TONE FREQUENCY	Selected from 67-210 Hz range
FREQUENCY DETERMINING DEVICE	"Vibrasender" Resonant Reed
STABILITY	±0.15%
LEVEL	350 mV rms @ 67 Hz, to 130 mV rms @ 210 Hz nominal
OUTPUT IMPEDANCE	4.7k ohms
POWER REQUIREMENTS	+9.6 V dc @ 15 mA

1. DESCRIPTION

The "Private-Line" (PL) encoder generates a low-frequency audio tone for continuous modulation of the transmitted rf signal in "Private-Line" operation.

NOTE

The tone signal is used only to unsquelch receivers in specific networks and is not heard. Refer to the DESCRIPTION section of this manual for an explanation of "Private-Line" network operation.

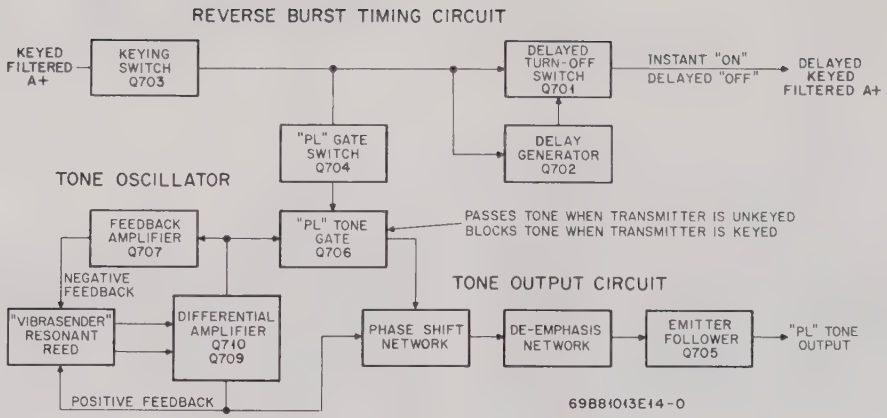
This solid-state PL encoder is constructed on a single plug-in circuit board which is easily removed and replaced. Components are mounted on the opposite side from the circuit plating.

2. FUNCTIONAL OPERATION

a. General

Refer to the PL encoder block diagram. The encoder may be divided into three major sections.

MOTOROLA INC. Communications Division
ENGINEERING PUBLICATIONS 1301 E. ALGONQUIN ROAD SCHAUMBURG, ILLINOIS 60172



"Private-Line" Encoder Block Diagram

● Tone Oscillator - The tone oscillator generates two equal amplitude tone signals 180° out-of-phase whenever power is applied to the radio. A feedback amplifier provides negative feedback to limit the level of oscillation. The "Vibrasender" resonant reed determines the frequency of operation.

● Reverse Burst Timing Generator - The reverse burst timing generator provides a transmitter turn-off delay of approximately 150 milliseconds after the transmitter is unkeyed. During this period, a shifted phase tone (reverse burst) is developed in the tone output circuit which dampens the oscillations of the "Vibrasponder" resonant reed in listening receivers to eliminate the "squelch tail" noise burst at the end of the message.

● Tone Output Circuit - The tone output circuit provides a fixed level tone output to the modulator of the transmitter and shifts the phase of the tone during the reverse burst period to rapidly dampen the "Vibrasponder" resonant reeds in listening receivers.

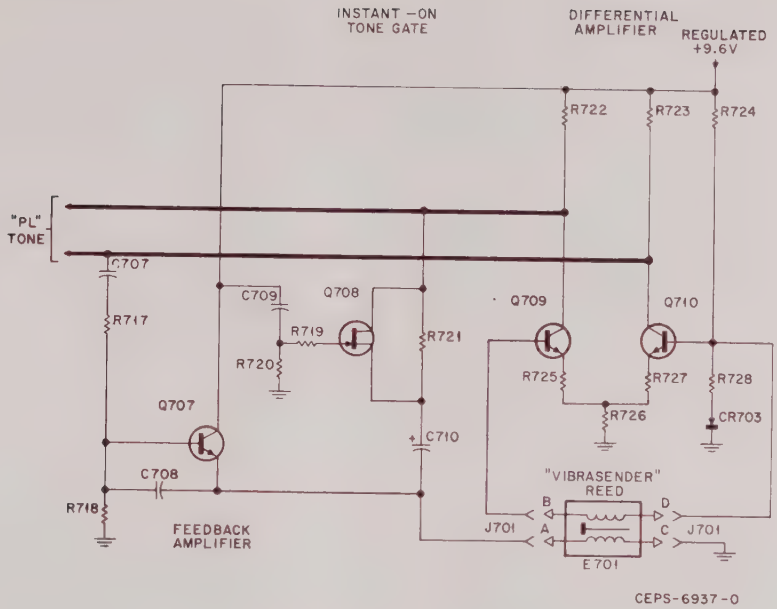
b. Tone Oscillator

The tone oscillator operates continuously when power is applied to the radio set. The outputs of the differential amplifier, formed by Q709 and Q710, are identical but 180° out-of-phase. The amplitudes of these collector signals are independent of frequency. A positive feedback signal is coupled through C710 and R721 to sustain oscillation. When the radio set is turned on, C709 begins to charge through R720 and turns on Q708 through R719. While on, Q708 acts as a resistor in shunt with R721 and increases the positive feedback to rapidly provide full output from the "Vibrasender" resonant reed. When the voltage across C709 reaches 9 volts (after approximately 1.5 seconds), Q708 turns off and has no further effect on the circuit operation. The output of Q709 is applied to feedback amplifier Q707 through C707 and R717. When the signal level exceeds a fixed amount, Q707 is biased into operation. It provides a negative feedback signal which keeps the oscillator out of limiting, thus providing a sinusoidal wave output. The "Vibrasender" resonant reed is the frequency determining device of the oscillator. It acts as a very high Q, narrow bandpass transformer, coupling only its resonant frequency and blocking all others. At its resonant frequency, the reed vibrates to couple energy from the primary to the secondary winding.

The "Vibrasender" resonant reed is a precision built device which maintains its frequency within ±0.15% of that specified. It consists of a tuned cantilever reed of special steel mounted on a rugged base with a coil and two permanent magnets. The entire assembly is spring-mounted and hermetically sealed in a metal housing to insure long life at peak performance under all types of conditions. The design of the reed eliminates the need for servicing throughout its useful life. The reed is a plug-in device which may be easily removed and replaced for circuit testing or to change frequencies. Reeds are available in specific frequencies in the 67-210 Hz range. No circuit adjustments are required when changing reeds.

AEPS-6111-O

"Vibrasender" Resonant Reed



Tone Oscillator Circuit

NOTE

"Private-Line" tone frequencies are assigned by Motorola Systems Engineering to prevent duplication or interference between tones in the same area. Consult them before changing frequencies.

c. Reverse Burst Timing Circuit

In the unkeyed transmitter condition, delay generator, Q702, is forward biased through CR701 and R707 to A- placing A+ across R704. This voltage is coupled to the base of the delayed turn-off switch (Q701) by R703, and Q701 is biased "off".

When the P-T-T button is closed, keyed filtered A+ is applied to R708 and turns on the keying switch, Q703. With Q703 acting as a short circuit:

-- Q701 is biased "on" through R702, CR702 and Q703 to A-.

-- Keyed, filtered A+ is applied through Q701 to turn on the transmitter.

-- C702 charges from the filtered A+ line through Q702 base-emitter junction, CR701 and R706.

-- The PL switch gate, Q704, is turned on by bias current through R709 and Q703. This action turns off PL tone gate, Q706.

Note that Q702 has not changed states and is still turned on by bias current through R707.

When the P-T-T button is released, the keyed, filtered A+ bias is removed from Q703 and it turns off. The transmitter continues to receive A+ from Q701 during the following sequence of events; with Q703 turned off:

-- The PL switch gate, Q704, is turned off, activating the PL tone gate, Q706, which passes the reverse burst tone signal.

-- C702 discharges through R706, R707, R704, R703 and R702, back biasing CR701 and turning off Q702.

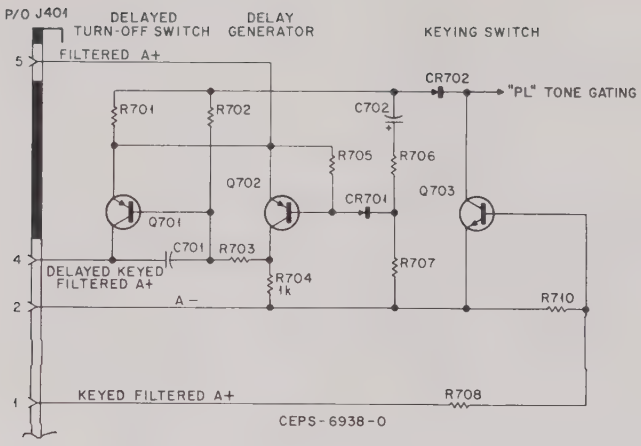
-- With Q702 off, Q701 remains on by receiving base bias through R703 and R704.

-- After approximately 150 milliseconds, the voltage across C702 decreases to the point where Q702 turns on again and applies A+ across R704.

-- The A+ across R704 turns off Q701 which removes the delayed keyed filtered A+ from the transmitter.

d. Tone Output Circuit

When the transmitter is keyed, PL gate switch Q704 is turned on. Q704, in turn, gates 9.6 volts to PL tone gate Q706, turning it off.



Reverse Burst Timing Circuit

When Q706 is turned off, only the output of Q710 is coupled to emitter follower Q705. When the transmitter is unkeyed, Q704 is turned off and Q706 is turned on which completes the tone path from Q709 to C706. The two tone signals 180° out-of-phase, combine through the phase shift capacitors to produce a signal to the emitter follower that is 240° out-of-phase with the original tone. R714 and C704 form a de-emphasis network with a -6 dB per octave characteristic. This allows any frequency reed to be used and still maintain ±.5 to 1 kHz PL-tone deviation of the transmitter signal. The de-emphasis network compensates for the +6 dB per octave pre-emphasis characteristic of the modulator. Emitter follower Q705 provides impedance matching to a low impedance output and isolates the tone oscillator from the external circuit to which the tone output is applied.

3. MAINTENANCE

a. Recommended Test Equipment

(1) Motorola SLN6221A "Private-Line" Tone Generator -- used for testing "Vibrasender" resonant reeds.

(2) Motorola Solid-State AC Voltmeter -- used for tone level measurement.

(3) General Purpose Oscilloscope -- valuable for signal tracing and locating sources of distortion.

(4) Motorola Solid-State DC Multimeter -- used for dc voltage measurement.

(5) Motorola S1324A Digital Frequency Meter or S1325A Digital Frequency & Deviation Meter -- used for measuring PL tone frequency.

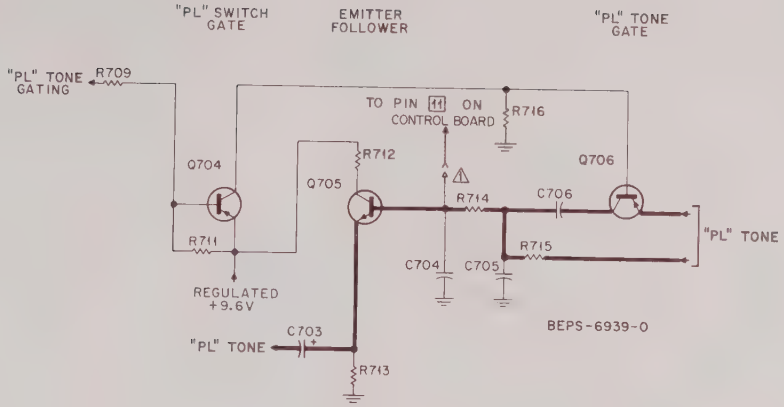
CAUTION

Care must be exercised if the radio is to be bench tested by the application of 12-volts directly to the radio transmitter and/or receiver stages. The power supply deck provides overvoltage and surge protection for these circuits; hence, an external power supply feeding the rf circuits directly must be well enough regulated to provide supply voltages that remain below harmful levels. Such a supply must provide a terminal voltage of 13.4 volts under full load with the transmitter keyed, but not exceed 16.5 volts (including transients) when switched to the no load (unkeyed) condition. Most power supplies will not meet this requirement; in fact, some SCR regulated power supplies have transient response that allows the output voltage to momentarily triple when switched from full load to no load. The following bench supplies are approved for testing the "Micor" radio when the power supply deck is bypassed:

Motorola S1303A or S1305A Regulated Power Supply.

Motorola T1261A Transistorized 24-Volt to 12-volt Converter driven by a Motorola T1012A Power Supply.

12-Volt automotive battery with a Motorola T1012A Power Supply used as a battery charger.



Tone Output Circuit

b. Performance Test

Measure frequency deviation of the transmitter in which the PL encoder is installed. With the transmitter keyed and PL tone modulation (only), deviation should read ±0.5 to ±1.0 kHz.

c. Troubleshooting

(1) If no deviation is measured, the trouble may lie in the tone oscillator or tone output circuit. The trouble may be isolated by the following steps.

(a) Check 9.6-volt input to encoder.

(b) Check ac signal voltage at collector of Q710.

(c) If signal is present, check Q705.

(d) If signal is present at Q710, check PL switch ON at control head. Remove "push-on" wire at base of Q705. If tone appears in transmitter audio, check for fault in encoder on-off circuitry on control board.

(e) If no signal is present, any component in the oscillator loop could cause the trouble. Check the "Vibrasender" resonant reed using the SLN6221A "Private-Line" Tone Generator.

(f) If the tone generator does not produce an output signal, the reed is defective.

(g) If the reed is good, replace it in the encoder and make dc voltage measurements in the tone oscillator circuit to locate the defective component.

(2) If low deviation is measured, check ac signal voltages and compare them with the schematic readings to find the source of trouble.

(3) If deviation is normal, but calls are not being received, check the frequency of the PL encoder tone. If off-frequency, replace the "Vibrasender" resonant reed.

(4) If squelch tail noise bursts are heard by all listening receivers, check dc voltages of Q702 and Q706 in keyed and unkeyed conditions.

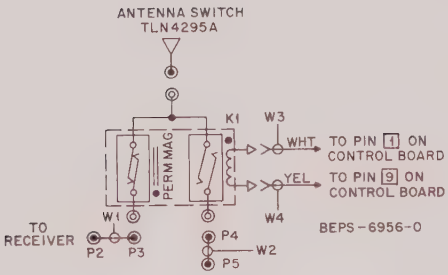
(5) If the transmitter cannot be keyed, and the trouble has been isolated to the PL encoder board, measure dc voltages in Q701 and Q703 stages.

(6) If too much tone deviation is measured, check feedback amplifier Q707.

ANTENNA SWITCH

MODEL TLN4295A

AEPS-6923-O



REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

PARTS LIST

IMPORTANT

USE ONLY THE FOLLOWING MOTOROLA PART NUMBERS WHEN ORDERING REPLACEMENT PARTS

Antenna Switch — PL-876-O

K1	TLN4295A	REED SWITCH: antenna switch NOTE Field servicing of this item not recommended, must be replaced as a unit.

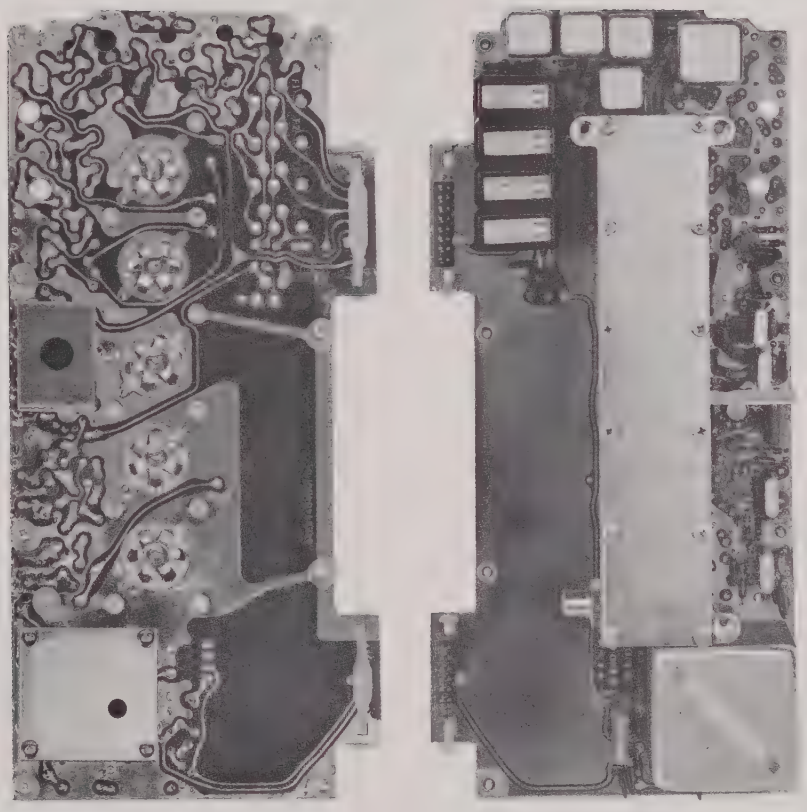
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
Associated Components (p/o TLN4580A)		PL-1315-A
		CONNECTOR, plug: male; coaxial;
P2	28-84237B02	miniature
P3	28-82365D03	miniature; right-angle type
P4	28-82365D03	miniature; right-angle type
P5	28-82365D03	miniature; right-angle type
		LINE, RF transmission:
W1	1V80709B38	includes P1, P2 and 30-83794C01 CABLE, RF: coaxial; 16" length required
W2	1V80709B70	includes P3, P4 and 30-82921H01 CABLE, RF: coaxial; 7" length required
W3	1V80707B12	WIRE ASSEMBLY, electrical: includes: 30-10286C58 WIRE, electrical; No. 22 ga; WHT; 10" length required 37-132562 TUBING, plastic; clear; 1" length required 29-82010D01 TERMINAL, contact: female (for round mating terminal) 39-10184A24 TERMINAL, contact: female (for flat mating terminal)
W4	1V80707B11	includes: 30-10286C59 WIRE, electrical; No. 22 ga; YEL; 10" length required 37-132562 TUBING, plastic; clear; 1" length required 29-82010D01 TERMINAL, contact: female (for round mating terminal) 39-10184A24 TERMINAL, contact: female (for flat mating terminal)
NON-REFERENCED ITEM		
	3-135841	SCREW, tapping: 6-32 x 1" plain hex head (ext. lock-washer); 2 required

MOTOROLA INC. Communications Division
ENGINEERING PUBLICATIONS 1301 E. ALGONQUIN ROAD SCHAUMBURG, ILLINOIS 60172

"MICOR" "SENSITRON" RECEIVER
RF & IF BOARD

TLD5270A SERIES

(FORMERLY TLD8270A SERIES)



TOP VIEW BOTTOM VIEW

BEPS-6143-O

MODEL TABLE

MODEL	FREQ. RANGE	FORMERLY CONSISTED OF:
TLD5273A	150.8-162 MHz	TLD8273A RECEIVER BOARD TLN5675A FILTER KIT
TLD5274A	162-174 MHz	TLD8274A RECEIVER BOARD TLN5675A FILTER KIT

MOTOROLA INC. Communications Division
ENGINEERING PUBLICATIONS 1301 E. ALGONQUIN ROAD SCHAUMBURG, ILLINOIS 60172

TECHNICAL CHARACTERISTICS

INPUT IMPEDANCE		50 ohms
RF FREQUENCY RANGE		150.8-174 MHz
CHANNEL ELEMENT FREQUENCY RANGE		15.455-18.055 MHz
CHANNEL SPACING		30 kHz
NUMBER OF CHANNELS		1 to 4
SELECTIVITY EIA SINAD		-100 dB @ ±30 kHz
INTERMODULATION EIA SINAD		-80 dB
MODULATION ACCEPTANCE EIA		±7 kHz
SENSITIVITY (50 OHMS RF INPUT IMPEDANCE)	20 dB Quieting	Less than 0.5 microvolt
	EIA Sinad	Less than 0.35 microvolt
OSCILLATOR (CHANNEL ELEMENT) STABILITY		±.0005% (±.0002% optional) from -30°C to +60°C ambient
SPURIOUS & IMAGE REJECTION		-100 dB
POWER REQUIREMENTS		Regulated 9.6 volts @ 70 mA 13.8 volts @ 20 mA
CONSTRUCTION		Fully solid-state, two integrated circuits
RECEIVER TYPE		FM superheterodyne single conversion
IF FREQUENCY		11.7 MHz
CRYSTAL FILTER TYPE		Dual resonator, mode coupled, monolythic crystal
DISCRIMINATOR TYPE		Dual resonator, mode coupled, monolythic crystal
METERING		Three test points critical to operation and alignment are accessible at a metering receptacle which permits testing with a Motorola portable test set or any 50 microampere meter.

1. DESCRIPTION

The fully solid-state receiver rf & i-f circuit board consists of an rf preselector, two integrated circuits, three transistors, two i-f crystal filters, plug-in channel elements, and a crystal discriminator. These components are used to develop a low-noise audio signal from a frequency modulated "on-channel" rf carrier in the 150.8-174 MHz range.

All circuits are constructed on a single plug-in circuit board which is easily removed and replaced. All external dc and audio connections are made at a single row of pins which eliminate interconnecting wires; rf input is provided by a single plug-in coaxial cable originating at the antenna switch. Circuit board plating is on both sides of the board with all components mounted on the bottom side. All alignment points are accessible from the top side of the radio.

2. FUNCTIONAL OPERATION

a. General

Refer to Figure 1. This circuit board is a highly selective, crystal controlled, single conversion FM receiver (less audio amplifier, squelch circuitry, and speaker). Bandwidth and selectivity characteristics are determined by rf preselector coils and i-f crystal filters. Plug-in crystal oscillator modules (channel elements) provide stable frequency control. Integrated circuits are used for all amplification and limiting after the first crystal filter section which produce high i-f signal gain and exceptionally high reliability. A crystal discriminator is used to provide high audio recovery from the i-f signal.

b. RF Preselector

RF preselector selectivity prevents receiver degradation from the mixer image frequency and

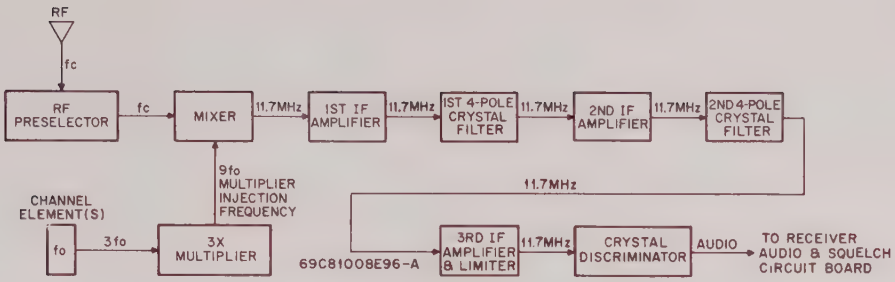


Figure 1.
Receiver RF & IF
Circuit Board Block Diagram

other high level off-channel signals. The rf preselector consists of five low loss, highly selective helical resonant cavities. The bandpass of the preselector is characterized by a flat acceptance bandwidth (preselector response within its bandpass does not vary) and a steep skirt response (attenuation of signals rapidly increases as their separation from the bandpass range increases).

Carrier signals received at the antenna are routed through the preselector cavities to the following mixer stage to be heterodyned with the injection frequency signal.

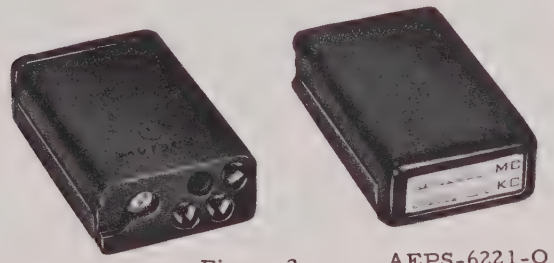


Figure 2. AEPS-6221-O
Channel Element

c. Oscillator (Channel Elements)

Channel elements are highly stable crystal-controlled oscillators. They use unheated crystals in an oscillator circuit that is temperature compensated over the entire temperature range of -30° to +65°C (-22° to +140°F). A variable warp capacitor for fine frequency adjustment in the base of each channel element is accessible through holes in the rf & i-f circuit board. Each channel element is a factory sealed, plug-in module.

If the optional, high stability, channel elements (±.0002%) are used, the Model TLN4440A AFC amplifier must also be used. Both units are plug-in modules and require no modifications to the radio set. The high stability receiver channel elements are inserted into the same respective locations as the standard receiver elements. The AFC amplifier is inserted next to the F4 receiver channel element location and can be used only with the high stability receiver elements.

The rf and i-f circuit board accepts up to four channel elements. One channel element is required for each frequency. An external frequency selector switch completes the dc ground path for the desired oscillator. Only one frequency may be selected at a time, but receiver operation is possible on as many as four separate frequencies. The channel element output is developed only when the switched 9.6-volt supply voltage is applied (when the transmitter is not "turned-on", or when the radio set is "netted"). Operation of the selected channel element may easily be checked with a Motorola portable test set on selector switch position 3.

The third harmonic of the highly stable output signal from the channel element is applied to the following multiplier circuitry where it is tripled in frequency. This results in an injection frequency to the mixer nine times the frequency of the channel element.

d. Multiplier

The frequency of the signal from the channel element is multiplied within this stage. The multiplier output frequency applied to the mixer is below (low side injection) the rf carrier frequency.

e. Mixer

The mixer uses a field effect transistor with low noise level and high conversion gain. The circuit heterodynes the signal from the rf preselector stage with the injection signal from

the multiplier to produce the intermediate frequency (i-f) of 11.7 MHz.

Frequency relationships for the 150.8-174 MHz range are expressed as follows:

$$f_o = \frac{f_c - 11.7\ \text{MHz}}{9}$$

Where:

f_o = channel element frequency.

f_c = rf carrier frequency.

9 = channel element harmonic.

11.7 MHz = mixer output frequency (i-f frequency).

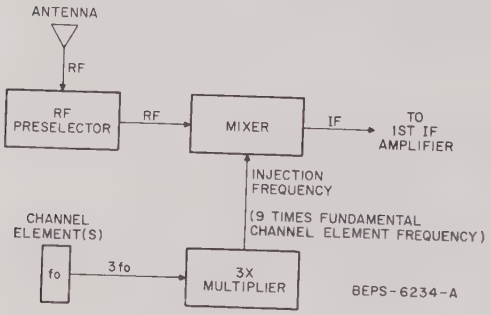


Figure 3.
Simplified Multiplier Diagram

f. First IF Amplifier

This stage uses a field effect transistor operating in a source follower configuration. This configuration matches mixer output impedance to the first four-pole crystal filter input impedance; preventing interaction between the two circuits. All components used in the first i-f amplifier stage through the third i-f amplifier and limiter stages are fixed in value, eliminating many previously required alignment points.

g. First Four-Pole Crystal Filter

This filter and the other four-pole crystal filters and the major factors in determining final receiver bandwidth and selectivity characteristics by greatly attenuating signals outside the predetermined receiver bandpass range.

The first four-pole filter consists of two dual-resonator, mode-coupled monolythic crystals and associated impedance matching circuitry. The output of the first i-f amplifier is coupled to the input of the filter by a fixed-tuned matching network.

Refer to Figure 4. Each crystal blank produces mechanical vibrations at the crystal input when an electrical intermediate frequency signal is applied. These vibrations occur due to the inherent piezoelectric property in the crystal material and are propagated throughout the crystal. This same piezoelectric property converts the mechanical vibrations back to an electrical intermediate

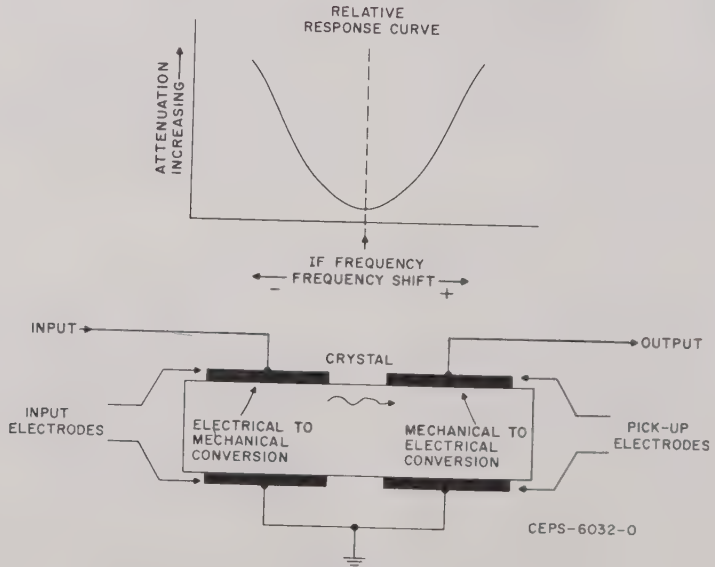


Figure 4.
Simplified Piezoelectric Coupling Diagram

frequency signal at the output electrodes. The high "Q" of the crystals creates the narrow bandpass of the filter which results in excellent off-channel signal rejection.

The output of the first four-pole crystal filter is coupled to the second i-f amplifier through another fixed-tuned matching network.

h. Second IF Amplifier

This circuit consists of an integrated circuit with associated discrete components to provide approximately 55 dB of gain to the i-f signal.

The IC contains two differential amplifier stages that are internally voltage regulated and temperature compensated. The output of the IC is applied to the input of the second four-pole crystal filter. Isolation between the two stages is provided internally within the IC.

i. Second Four-Pole Crystal Filter

The crystals in this filter operate in a manner identical to that of the crystals in the first four-pole crystal filter described previously. Final receiver selectivity is established at this filter. The output of this filter is coupled to the third i-f amplifier and limiter stage by a fixed-tuned matching network.

j. Third IF Amplifier and Limiter

The third i-f amplifier and limiter consists of an integrated circuit with associated discrete components and performs two functions: (1) amplification and (2) limiting.

This stage is similar to the second i-f amplifier in that it has internal voltage regulation and temperature compensation. However, it employs four differential amplifier stages instead of two. The first two differential amplifier stages provide approximately 55 dB of gain to the i-f signal. The output of the second stage is used to provide metering (Meter 5). Its output is applied to the third differential amplifier stage which along with the fourth stage also, becomes overdriven to provide excellent symmetrical limiting characteristics.

Full limiting occurs with weak or strong signals or noise only.

The limited output of this IC provides a signal of constant amplitude to the discriminator. This is necessary since the discriminator would respond to a change in amplitude as well as to a change in frequency.

k. Crystal Discriminator

The discriminator used is a phase discriminator. The operation is dependent upon a 90° phase shift which occurs at resonance between the input and output voltages of the dual-resonator crystal, (similar to a double-tuned, inductive coupled transformer).

Crystals inherently have a much more rapid change in phase shift than coils due to their high Q. Therefore, the steeper slope of a crystal discriminator will produce a much greater audio output voltage than a coil discriminator for given deviation in frequency. Typical response curves are shown in Figure 5 for comparison. The i-f signal varies in frequency at the audio rate. This is shown below the curve. The corresponding audio outputs are drawn to the right of the curve.

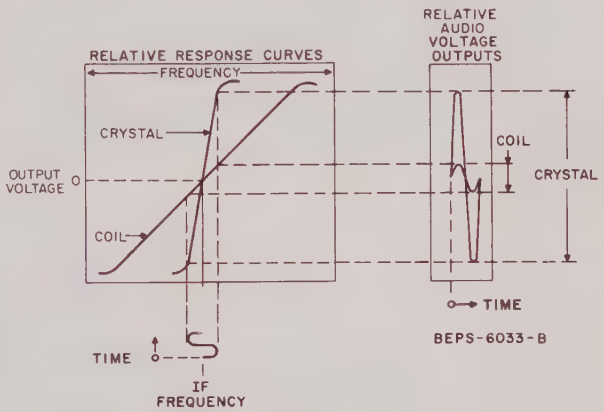


Figure 5.
Typical Discriminator Response Comparison Diagram

Figure 6 is a simplified drawing of the discriminator circuit. The component reference symbol letters do not correspond to the components shown on the schematic diagram but are used to simplify the discussion. The tuned circuit formed by L and series connected C_1 and C_2 is resonant at 11.7 MHz.

When the frequency of the applied primary voltage (EP) is changed, the phase angle between E_P and E_S (secondary voltage) changes from that at resonance. This changes the relative magnitude of E_1 and E_2. The phase relationships are shown in Figure 7.

The output voltages from D1 and D2 are developed across R1 and R2. The circuit is such that the output voltage (E_{OUT}) is equal to the

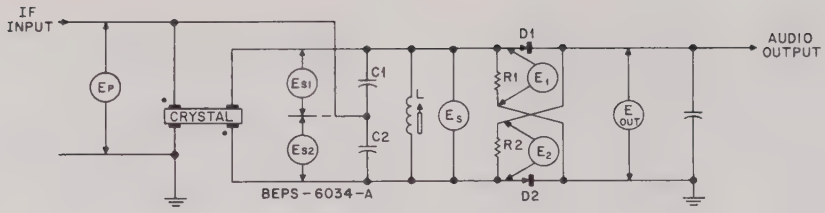


Figure 6.
Discriminator Circuit Simplified

difference between these two separate voltages. This means that when the frequency of the carrier, after conversion in the mixer, is exactly equal to the 11.7 MHz intermediate-frequency, no output will be obtained from the diodes because the voltage drops are equal and opposite (zero adjustment in the receiver alignment procedure). As the signal deviates from the intermediate frequency of 11.7 MHz, an output voltage will appear at E_{OUT}, as shown in Figure 6. The polarity of the voltage depends upon the magnitude of the voltages across R1 and R2. For the diode polarity shown, the discriminator output is positive below 11.7 MHz, where the phase angle changes and E_1 is greater than E_2, as shown in Figure 7. Above 11.7 MHz, the phase shift makes E_2 greater than E_1 and the output is negative.

3. MAINTENANCE

CAUTION

Care must be exercised if the radio is to be bench tested by the application of 12-volts directly to the radio transmitter and/or receiver stages. The power supply deck provides overvoltage and surge protection for these circuits; hence, an external power supply feeding the rf circuits directly must be well enough regulated to provide supply voltages that remain below harmful levels. Such a supply must provide a terminal voltage of 13.4 volts under full load with the transmitter keyed, but not exceed 16.5 volts (including transients) when switched to the no load (unkeyed) condition. Most power supplies will not meet this requirement; in fact, some SCR regulated power supplies have transient response that allows the output voltage to momentarily triple when switched from full load to no load. The following bench supplies are approved for testing the "Micor" radio when the power supply deck is bypassed:

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Motorola T1261A Transistorized 24-Volt to 12-volt Converter driven by a Motorola T1012A Power Supply.

12-volt automotive battery with a Motorola T1012A Power Supply used as a battery charger.

a. General

This section of the manual provides the maintenance shop type procedures for the receiver rf and i-f section of the radio set. These bench tests include measurements with a Motorola portable test set, and procedures for testing and troubleshooting; including integrated circuit check-out.

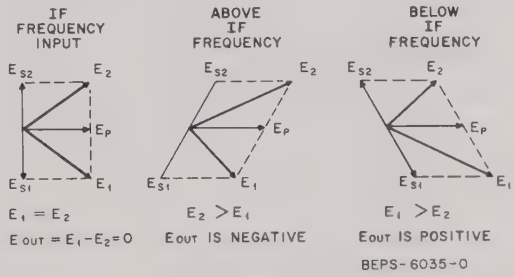


Figure 7.
Discriminator Phase Relationships

NOTE

The receiver rf and i-f board must be installed in a radio set for testing to provide the necessary power, ground, control and signal connections. The board should always be secured in place with all mounting screws for operation and testing to provide a good rf ground to all stages of the receiver.

b. 20 dB Quieting Sensitivity Test

This performance test may be used after repair and alignment to assure that the receiver

meets all specifications before it is returned to service.

The 20 dB quieting sensitivity should be 0.5 microvolt, or less. Refer to Figure 8.

NOTE

The receiver shield must be in place while performing this test.

(1) Unsquelch the radio set by turning the SQ (squelch) control on the control board fully counterclockwise. "Private-Line" radios must be PL disabled by placing the PL monitor switch in the OFF position.

(2) Connect the red "control" plug of the adapter cable to the control receptacle on the radio set.

(3) Set the multiplier switch on the test set in the 2 V AC position.

(4) Adjust the VOL (volume) control on the control board until 2 volts is obtained on meter position 11. To silence the speaker during the test, set the speaker switch of the test set in the LOAD position and disconnect the speaker.

(5) Connect the signal generator to the radio set antenna receptacle and adjust it to the receiver frequency.

(6) Adjust the signal generator output until the meter drops to 0.2 volt in meter position 11 (place the multiplier switch in the .2 V AC position). The generator output level now indicates the 20 dB noise quieting sensitivity and should be 0.5 microvolt, or less.

c. Troubleshooting

(1) Test Set Measurements

(a) General

A failure in almost any part of the rf and i-f section will produce an improper meter reading on one or more of the test points. Improper alignment will also cause improper meter readings. With the Motorola test set connected to the receiver rf and i-f board metering receptacle, readings

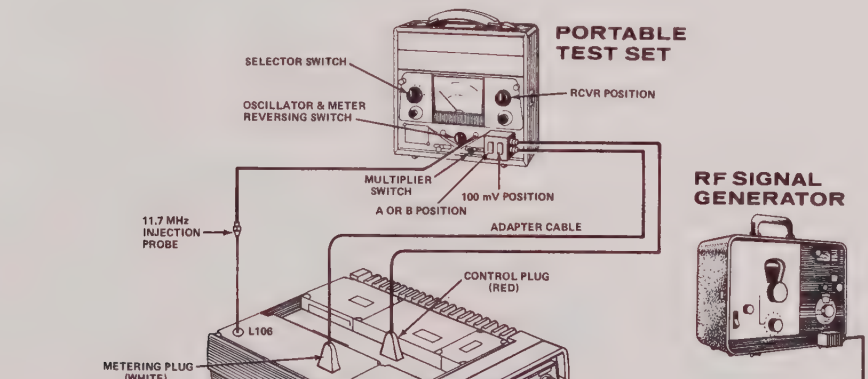


Figure 8.
20 dB Quieting Sensitivity Test

may be obtained by merely turning a selector switch on the test set.

A "0" meter reading in position 3 or 5 indicates either (1) insufficient drive from a preceding stage or (2) a defective component at the metering point.

(b) Procedure (Refer to Figure 9).

1. Connect the 20-pin plug of the adapter cable to the test set. When the test set is not in use, disconnect the 20-pin plug to conserve test set battery life. The plug acts as an on-off switch completing the battery circuit.

2. Connect the red "control" plug of the adapter cable to the receptacle on the control circuit board of the radio set. Connect the white "metering" plug of the adapter cable to the metering receptacle on the receiver rf and i-f circuit board.

3. Set up the portable test set and power as shown in Figure 9.

4. Compare the current readings in SELECTOR SWITCH positions 3, 4 and 5 with those in the following table. A low reading on meter position 3 indicates a defective channel element or multiplier circuit. Improper meter position 4 or 5 readings indicate a malfunction elsewhere in the receiver, which can most rapidly be found by checking rf and i-f voltages per the schematic diagram.

TYPICAL RECEIVER RF & IF METER READINGS TABLE (No Input Signal Applied)

SELECTOR SWITCH POSITION	READING (MICROAMPS)	CIRCUIT METERED
3	15	Channel Element Output
4	0 ±2	Discriminator Output
5	1 or less (If unreadable, inject 1.0 V on-channel signal at antenna receptacle; 20 uA, typical, should be obtained.	3rd i-f amplifier and limiter

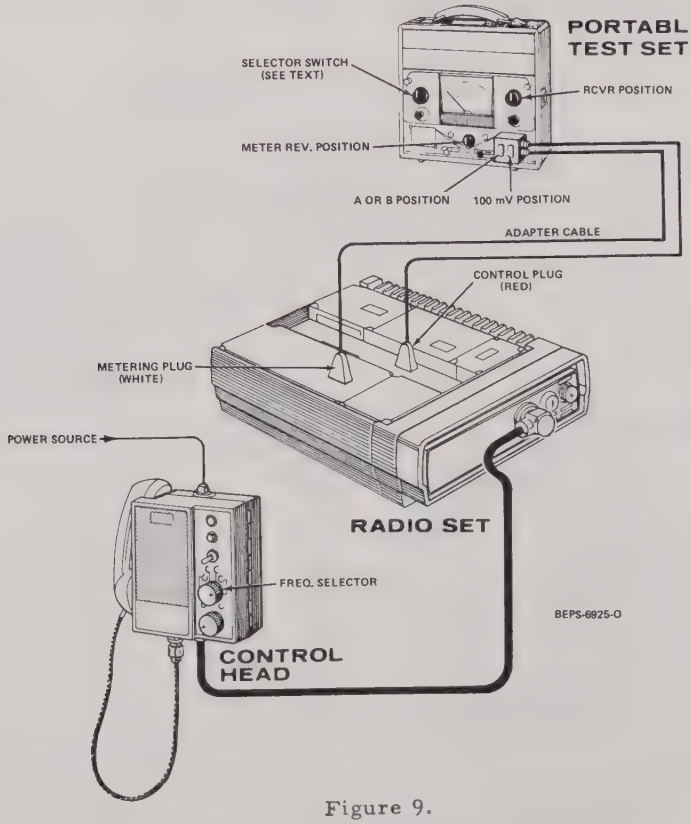


Figure 9.
Receiver RF & IF Metering Test Set-Ups

(2) Input Voltages

If these are no test set indications at one or more of the metered points, check the dc input voltages to the receiver rf and i-f circuit board. Key and unkey the transmitter to see if the voltages are switched.

P904-9	Filtered A+ (13.8 V dc with reference to chassis)
P904-6	9.6 V dc switched (with reference to chassis) (±0.5 V)
P904-13	9.6 V dc regulated (with reference to chassis) (±0.5 V)

If test set indications localize the trouble to a specific stage or two, measure the dc input voltages to the suspected stages. Refer to the schematic diagram for the normal voltages.

(3) Alignment as a Troubleshooting Technique

Low test set readings, improper discriminator output, and otherwise abnormal performance are very often corrected by re-alignment. Therefore, alignment should be the first troubleshooting step performed for these symptoms. Many technicians prefer to use alignment as the first troubleshooting step in all cases.

(4) Isolating Defective Components

If test set readings are abnormal or tests indicate sub-normal performance, a logical troubleshooting procedure is required to isolate the defective component. The accompanying troubleshooting chart summarizes troubleshooting in a logical sequence. A few voltage and resistance checks in the suspected circuit should readily isolate the defective component.

(5) Troubleshooting Integrated Circuits

Integrated circuits (IC's) are very reliable components and should not be replaced until all checks have proven definitely that the IC is the defective component. Removal of an IC is time consuming and often ruins the part. Therefore, a few extra checks before that task is attempted are worthwhile. Before replacing a bad IC, make sure that the external components in the circuit are normal.

The IC's in the receiver rf and i-f section may be checked by dc voltage measurements. Proper voltages are shown on the schematic diagram.

(6) Troubleshooting Crystals

A defective filter crystal can best be found by performing an i-f gain check per the schematic diagram. A defective crystal will show an abnormally high insertion loss. Before making the gain check, verify, using an ohmmeter, that the center pins of all four filter crystals are connected to the associated crystal case. The resistance between the center pin and the case should be less than 0.1 ohm. The loss of this ground may cause errors in gain measurements because of the loss of shielding effectiveness. If the filter is found to be defective because of high insertion loss or an ungrounded case, it should be replaced.

Before replacing the discriminator crystal, verify that all components associated with the discriminator circuitry are not defective. Also, verify, in a manner similar to that used for the filter crystals, that pin 2 is connected (less than 0.1 ohm) to the crystal case. The discriminator crystal should be replaced if found defective.

NOTE

If the discriminator crystal, Y105, is replaced, it must be physically oriented so that the index dot on the top of the filter can is toward IC102 on the circuit board. This crystal matches specific input and output impedances and will not perform satisfactorily if reversed. All other filter crystals, if replaced, may be oriented in either direction.

(7) Troubleshooting in the Optional AFC Amplifier

If the AFC amplifier is suspected to be malfunctioning, perform the following test:

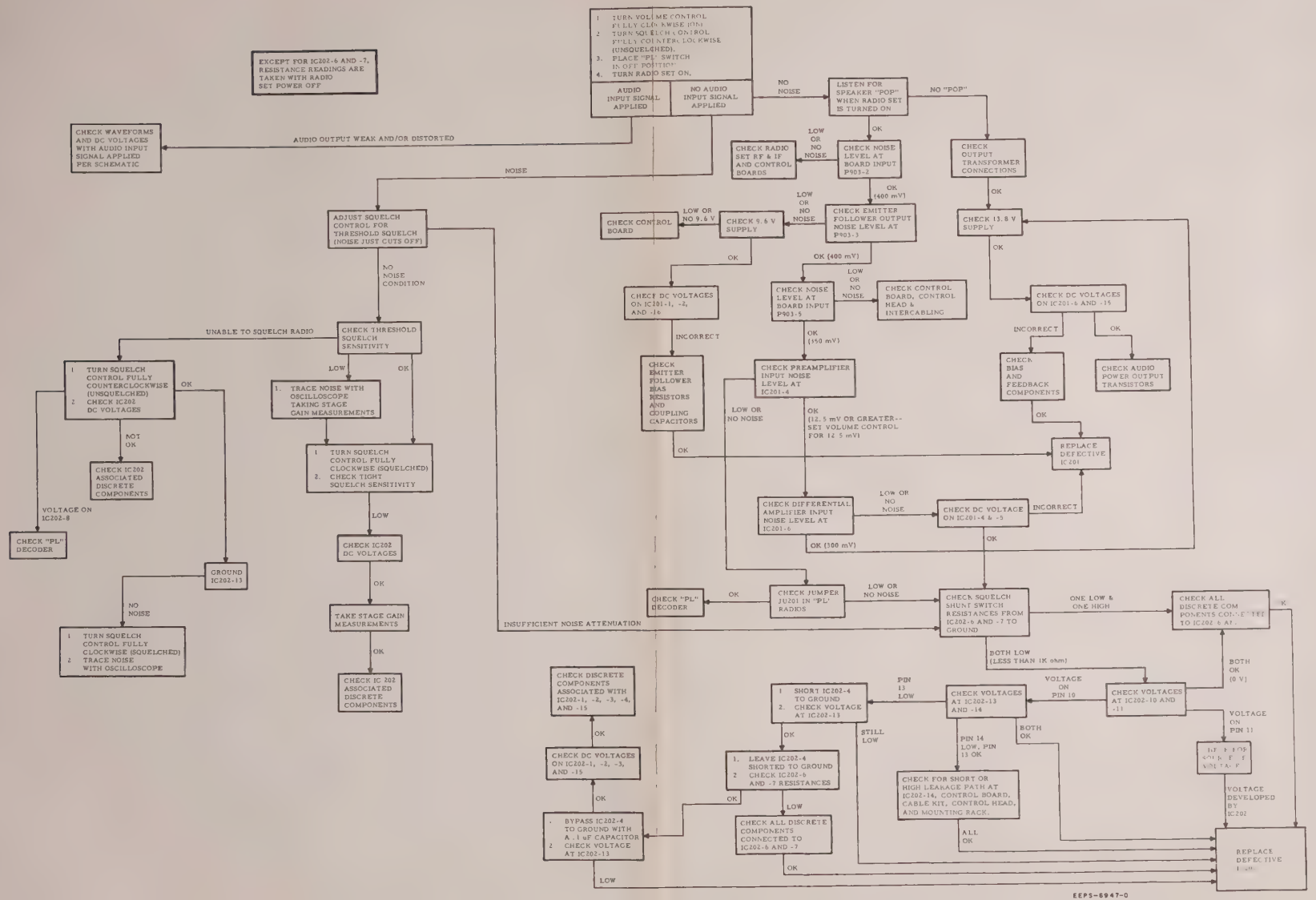
(a) Connect the Motorola test set to monitor the discriminator output (position 4).

(b) Insert a shorting tool into the AFC DISABLE (short contact on board to receiver shield) and adjust the input signal or the receiver channel element warping capacitor for a test set meter indication of approximately 5 uA off zero center scale.

(c) Remove the shorting tool to activate the AFC amplifier. The test set meter indication should return to within 2 uA of zero center scale.

RECEIVER AUDIO & SQUELCH BOARD

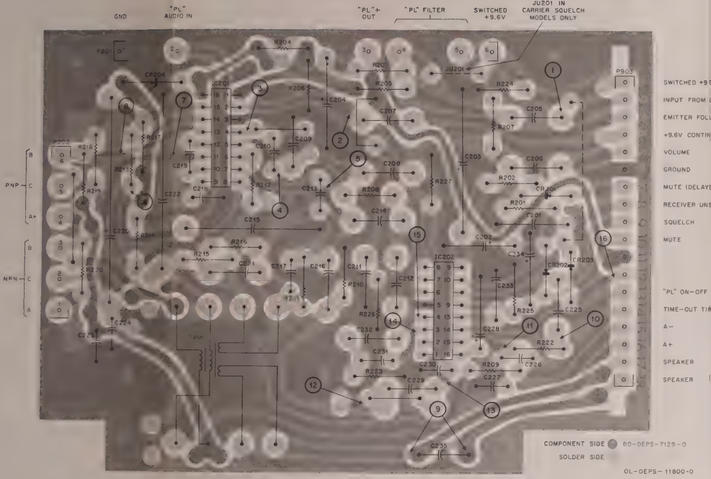
TROUBLESHOOTING CHART



AUDIO & SQUELCH BOARD COMPONENT LOCATIONS

REF. SYM.	LOCATION	REF. SYM.	LOCATION
C201	B4	CR201	B5
C202	B4	CR202	C4
C203	B4	CR203	C5
C204	A3	CR204	A1
C205	A5	IC201	A2
C206	B5	IC202	C4
C207	A3	R201	B4
C208	B3	R202	B4
C209	B3	R203	A3
C210	B2	R204	A2
C211	C3	R205	A3
C212	C3	R206	A3
C213	B3	R207	A4
C214	B3	R208	B3
C215	B2	R209	C4
C216	C3	R210	C3
C217	C2	R211	C3
C218	B2	R212	B2
C219	B2	R213	B1
C220	B1	R214	B1
C221	C2	R215	C2
C222	B2	R216	B2
C223	C1	R217	A1
C224	C1	R218	B1
C225	C5	R219	B1
C226	D4	R220	C1
C227	D4	R222	C4
C228	C4	R223	D3
C229	D4	R224	A4
C230	D4	R225	C4
C231	C3	R226	C3
C232	C3	R227	B4
C233	C4	T201	D2
C234	C4		
C235	D4		

EPS-11801-O



80-DEPS-7129-O

OL-DEPS-11800-O

RECEIVER AUDIO & SQUELCH BOARD

201. +5.6 VOLTS WHEN THRESHOLD SIGNAL JUST OPENS SQUELCH (I.E., APPROXIMATELY 6 dB QUIETING SIGNAL WITH SQUELCH CONTROL AT THRESHOLD).
202. WHERE MORE THAN ONE VOLTAGE READING APPEARS: USQ = RECEIVER UNSQUELCHED FSQ = RECEIVER FULLY SQUELCHED
203. VOLTAGE MEASURED IN RESPECT TO A-.
204. VOLTAGE MEASURED IN RESPECT TO A+.
205. VOLTAGES AT IC201-6 AND -7 MUST BE THE SAME VALUE.
206. UNLESS OTHERWISE STATED: CAPACITOR VALUES ARE IN PICOFARADS.
207. UNLESS OTHERWISE STATED, VOLTAGE MEASUREMENTS ARE FOR DC VOLTAGES MEASURED WITH AN 11 MEGOHM INPUT RESISTANCE VOLTMETER IN RESPECT TO CHASSIS GROUND.

EPS-6799-O

VERSION 2

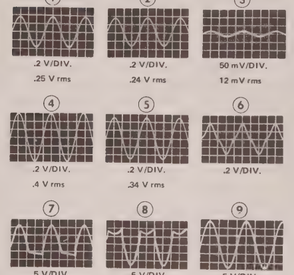
TLN4310A-5

ALL AUDIO CIRCUIT OSCILLOSCOPE WAVE FORMS TAKEN UNDER FOLLOWING CONDITIONS:

1. VERTICAL SENSITIVITY SHOWN UNDER EACH WAVEFORM.
2. HORIZONTAL DEFLECTION = .25 msec/DIV.
3. SQUELCH CONTROL FULLY COUNTERCLOCKWISE (OFF). 1000 uV RF SIGNAL INPUT MODULATED WITH 1000 Hz TONE WITH ±3.3 kHz DEVIATION.
4. VOLUME CONTROL SET FOR 9.0 V rms AT LOAD.
5. OUTPUT TERMINATED IN 8-OHM LOAD.

EPS 6798 O

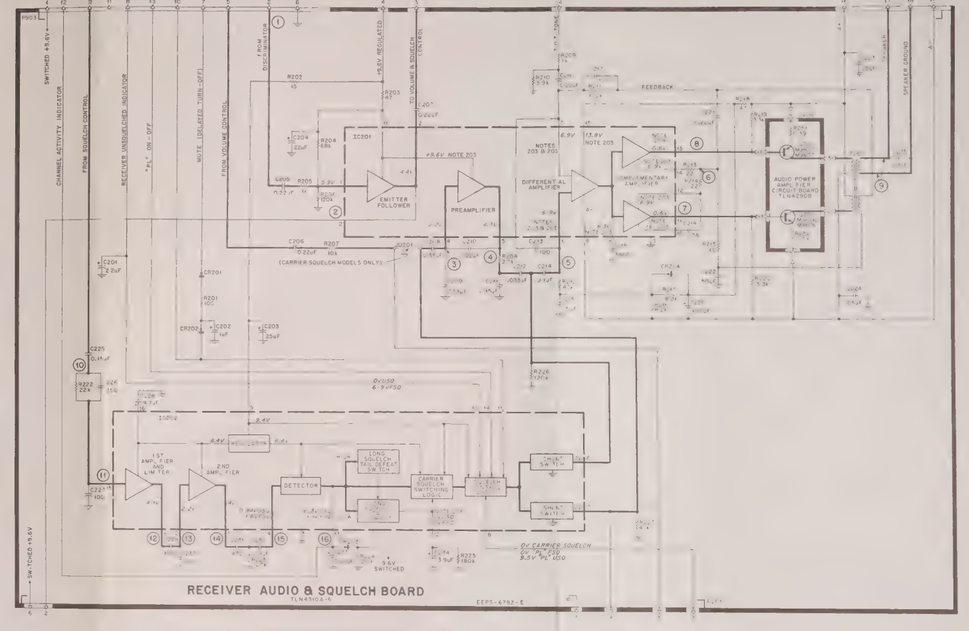
AUDIO CIRCUIT WAVEFORMS



DC VOLTAGE TABLE FOR IC'S

IC201 PIN	VOLTAGE	PIN	VOLTAGE	IC202 PIN	VOLTAGE	PIN	VOLTAGE
1	5.9 V	9	6.3 V NOTE 203	1	4.1 V	9	9.4 V
2	4.4 V	10	1.0 V NOTE 203	2	2.2 V	10	0 V USQ 6.0 8.0 V FSQ
3	0 V	11	0.6 V NOTE 203	3	4.0 V	11	—
4	2.2 V	12	6.8 V NOTE 203	4	0.54 V USQ 1.6 V FSQ	12	0 V USQ 0 V FSQ NOTE 201
5	4.3 V	13	0.6 V NOTE 204	5	0V	13	6.3 V USQ 1.1 V FSQ
6	6.8 V NOTES 203 & 205	14	6.8 V NOTE 203	6	0 V	14	—
7	6.8 V NOTES 203 & 205	15	13.8 V NOTE 203	7	0 V	15	2.2 V
8	A-	16	9.6 V NOTE 203	8	0 V CARRIER SQ 9.5 V "PL" USQ 6 V "PL" FSQ	16	6.4 V

EPS 6359-B

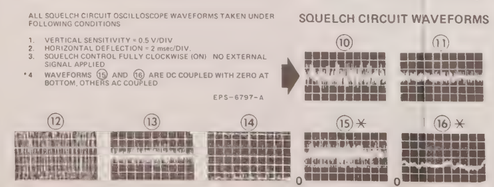


SQUELCH CIRCUIT WAVEFORMS

ALL SQUELCH CIRCUIT OSCILLOSCOPE WAVEFORMS TAKEN UNDER FOLLOWING CONDITIONS

1. VERTICAL SENSITIVITY = 0.5 V/DIV
2. HORIZONTAL DEFLECTION = 2 msec/DIV
3. SQUELCH CONTROL FULLY CLOCKWISE (ON). NO EXTERNAL SIGNAL APPLIED.
4. * WAVEFORMS (15) AND (16) ARE DC COUPLED WITH ZERO AT BOTTOM. OTHERS AC COUPLED.

EPS-6797-A



PREVIOUS REVISIONS AND PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

Model TLN4310A Receiver Audio & Squelch Schematic Diagram and Circuit Board Detail
Motorola No. 63P81013E22-B
7/29/74-NPC

AUDIO & SQUELCH BOARD

REVISIONS

PEPS-6932-B

CHASSIS AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
TLN4[illegible]A-[illegible]		EXTENSIVE [illegible] BOARD CHANGES.	
TLN431[illegible]A-6	R221	DELETED 6-127802 1K	T201 OUTPUT
	C235	ADDED 8-82905G30, 0.1 µF REPLACES R221	

Model TLN4310A Receiver
Audio & Squelch Board
Mechanical and Electrical Parts List
Motorola No. PEPS-6932-B
7-29-74-NPC

ELECTRICAL PARTS LIST

IMPORTANT

USE ONLY THE FOLLOWING MOTOROLA PART NUMBERS WHEN ORDERING REPLACEMENT PARTS

TLN4310A Audio & Squelch Board PL-1296-B

REFERENCE SYMBOL	MOTOROLA PART NO	DESCRIPTION
		CAPACITOR, fixed: µF, ±10%, unl. stated
C201	23-84762H04	2.2 ±20%, 25 V
C202	23-84762H06	1 ±20%, 35 V
C203	23-83210A01	25 +150-10%, 25 V
C204	23-84762H010	22 ±20%, 15 V
C205	8-83813H11	0.22, 75 V
C206	8-83813H11	0.22, 75 V
C207	8-83813H11	0.22, 75 V
C208	8-83813H29	0.33, 50 V
C209	8-83813H09	.033, 100 V
C210	21-82187B27	.022, 100 V
C211	8-83813H32	.015, 100 V
C212	8-83813H[illegible]	.033, 100 V
C213	21-84426B05	100 pF ±5%, 500 V
C214	8-83813H06	0.1, 100 V
C215	23-84081B03	75 +150-10%, 15 V non-polar
C216	8-83813H11	0.22, 75 V
C217	21-84493B05	1000 pF, 200 V; N2200
C218	21-82187B43	.0039, 100 V
C219	21-83406D46	56 pF ±5%, 100 V, N150
C220	23-83210A08	100 ±20%, 25 V
C221	8-82905G32	0.22, 50 V
C222	23-84081B01	50 +100-10%, 25 V, non-polar
C223	21-82372C04	.05 +80-20%, 25 V
C224	21-82372C04	.05 +80-20%, 25 V
C225	8-83813H07	0.15, 75 V
C226	21-848159	750 pF, 300 V
C227	21-82610C58	100 pF, 100 V, N750
C228	23-84762H07	4.7 ±20%, 25 V
C229	21-84493B05	1000 pF, 100 V, N2200
C230	21-84426B06	100 pF ±5%, 500 V
C231	21-84426B11	470 pF ±5%, 500 V
C232	8-83813H31	.01, 50 V
C233	8-83813H11	0.22, 75 V
C234	23-84762H08	3.9 ±20%, 15 V
C235	8-82905G30	0.1, 50 V
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR201	48-83654H01	silicon
CR202	48-83654H01	silicon
CR203	48-83654H01	silicon
CR204	48-82256C38	silicon, Zener type, 9.1 V ±0.45 V
		INTEGRATED CIRCUIT:
IC201	51-84267A08	type MC708
IC202	51-84267A09	type MC709
		CONNECTOR, receptacle
P201		consists of 6 male contact terminals (Part No. 29K855943) mounted on edge of circuit board
P202		consists of 6 male contact terminals (Part No. 29K855943) mounted on edge of circuit board
P903		consists of 16 male contact terminals (Part No. 29C84028H01) mounted on edge of circuit board
		RESISTOR, fixed: ±5%, 1/4 W, unl. stated
R201	6-129753	100 ±10%
R202	6-131377	15 ±10%
R203	6-129233	47 ±10%
R204	6-129299	68k
R205	6-127802	1k ±10%
R206	6-131446	120k
R207	6-129668	10k
R208	6-129707	2.7k
R209	6-127802	1k ±10%
R210	6-129819	3.9k
R211	6-129226	100k ±10%
R212	6-131527	47k
R213	6-124A09	22
R214	6-124A09	22
R215	6-129755	10 ±10%
R216	6-129983	8.2k
R217	6-129983	8.2k
R218	6-129233	47 ±10%
R219	6-129981	3.3k
R220	6-129981	3.3k
R222	6-129667	22k
R223	6-124886	27k
R224	6-124231	3.3k ±10%
R225	6-129229	180k ±10%
R226	6-128987	120k ±10%
R227	6-128902	47k ±10%
		TRANSFORMER, AF:
T201	25-84083B02	pri: split bifilar winding; res (each section) 0.25 ohms max sec: res 0.8 ohms max feedback: res 2 ohms max. NOTE: "Feedback side" coded with a paint mark

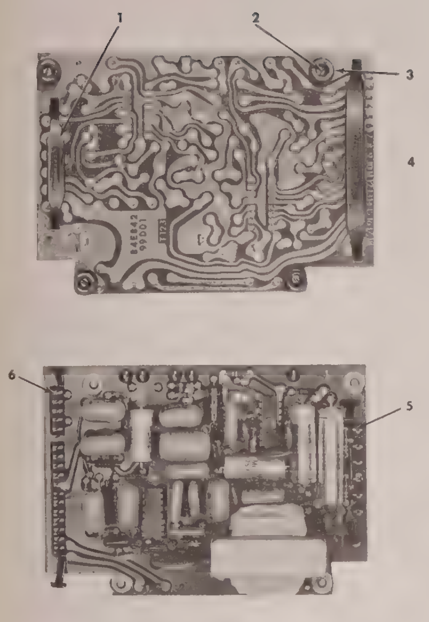
NOTE:

Replacement diodes must be ordered by Motorola part number only for optimum performance.

AUDIO & SQUELCH BOARD

TLN4310A Audio & Squelch Board
TLN4622A Audio & Squelch Board PL-852-C

CODE NO.	MOTOROLA PART NO.	DESCRIPTION
1	55B84300B02	HANDLE (short)
2	3S136905	LOCKSCREW, tapping: #4 x 5/16" (4 req'd)
3	42C84284B01	RETAINER, screw (4 req'd)
4	55B84300B01	HANDLE (long)
5	29C84028H02	PIN (short)
6	29C84028H01	PIN (long)

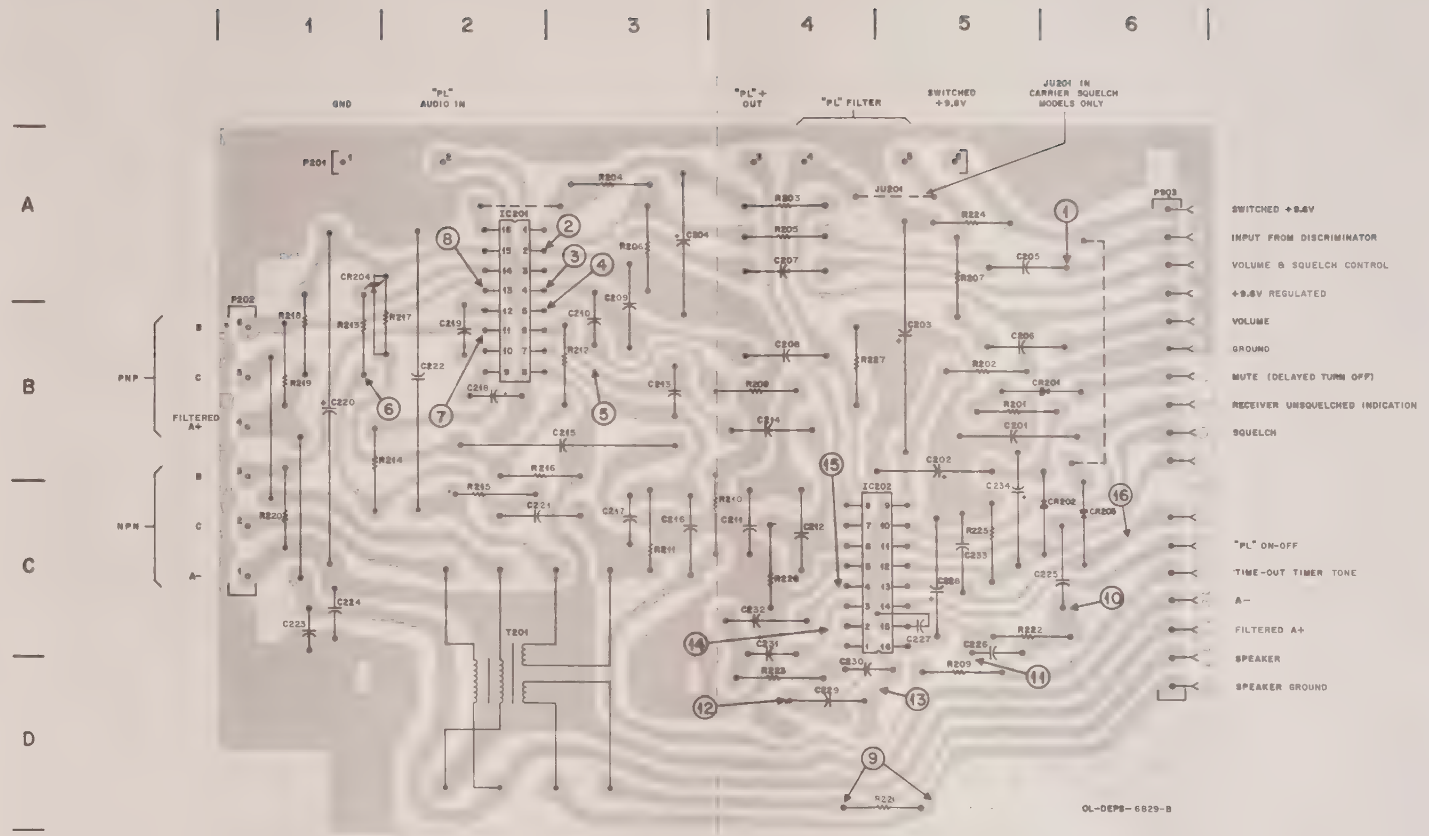


AEPS-7240-O

AUDIO & SQUELCH BOARD COMPONENT LOCATIONS

REF. SYM.	LOCATION	REF. SYM.	LOCATION
C201	B5	CR201	B6
C202	B5	CR202	C6
C203	B5	CR203	C6
C204	A3	CR204	B1
C205	A5	IC201	A2
C206	B5	IC202	C5
C207	A4	R201	B5
C208	B4	R202	B5
C209	B3	R203	A4
C210	B3	R204	A3
C211	C4	R205	A4
C212	C4	R206	A3
C213	B3	R207	A5
C214	B4	R208	B4
C215	B3	R209	D5
C216	C3	R210	C4
C217	C3	R211	C3
C218	B2	R212	B3
C219	B2	R213	B1
C220	B1	R214	B1
C221	C2	R215	C2
C222	B2	R216	B2
C223	C1	R217	B2
C224	C1	R218	B1
C225	C6	R219	B1
C226	C5	R220	C1
C227	C5	R221	D5
C228	C5	R222	C5
C229	D4	R223	D4
C230	D4	R224	A5
C231	C4	R225	C2
C232	C4	R226	C4
C233	C5	R227	B4
C234	C5	T201	D2
C235	D5		

EPS-6931-A



VERSION 1

TLN4310A-2 TO TLN4310A-4

AUDIO & SQUELCH BOARD COMPONENT LOCATIONS

REF. SYM.	LOCATION	REF. SYM.	LOCATION
C201	B4	CR201	B5
C202	B4	CR202	C4
C203	B4	CR203	C5
C204	A3	CR204	A1
C205	A5	IC201	A2
C206	B5	IC202	C4
C207	A3	R201	B4
C208	B3	R202	B4
C209	B3	R203	A3
C210	B2	R204	A2
C211	C3	R205	A3
C212	C3	R206	A3
C213	B3	R207	A4
C214	B3	R208	B3
C215	B2	R209	C4
C216	C3	R210	C3
C217	C2	R211	C3
C218	B2	R212	B2
C219	B2	R213	B1
C220	B1	R214	B1
C221	C2	R215	C2
C222	B2	R216	B2
C223	C1	R217	A1
C224	C1	R218	B1
C225	C5	R219	B1
C226	D4	R220	C1
C227	D4		
C228	C4	R222	C4
C229	D4	R223	D3
C230	D4	R224	A4
C231	C3	R225	C4
C232	C3	R226	C3
C233	C4	R227	B4
C234	C4	T201	D2
C235	D4		

EPS-11801-O

RECEIVER AUDIO & SQUELCH BOARD

201. +5.6 VOLTS WHEN THRESHOLD SIGNAL JUST OPENS SQUELCH (I.E., APPROXIMATELY 6 dB QUIETING SIGNAL WITH SQUELCH CONTROL AT THRESHOLD).
202. WHERE MORE THAN ONE VOLTAGE READING APPEARS: USQ = RECEIVER UNSQUELCHED FSQ = RECEIVER FULLY SQUELCHED
203. VOLTAGE MEASURED IN RESPECT TO A-.
204. VOLTAGE MEASURED IN RESPECT TO A+.
205. VOLTAGES AT IC201-6 AND -7 MUST BE THE SAME VALUE.
206. UNLESS OTHERWISE STATED: CAPACITOR VALUES ARE IN PICOFARADS.
207. UNLESS OTHERWISE STATED, VOLTAGE MEASUREMENTS ARE FOR DC VOLTAGES MEASURED WITH AN 11 MEGOHM INPUT RESISTANCE VOLTMETER IN RESPECT TO CHASSIS GROUND.

EPS-6799-O

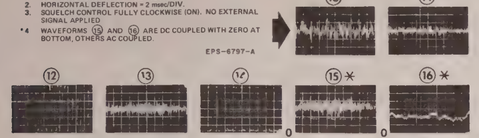
ALL SQUELCH CIRCUIT OSCILLOSCOPE WAVEFORMS TAKEN UNDER FOLLOWING CONDITIONS:

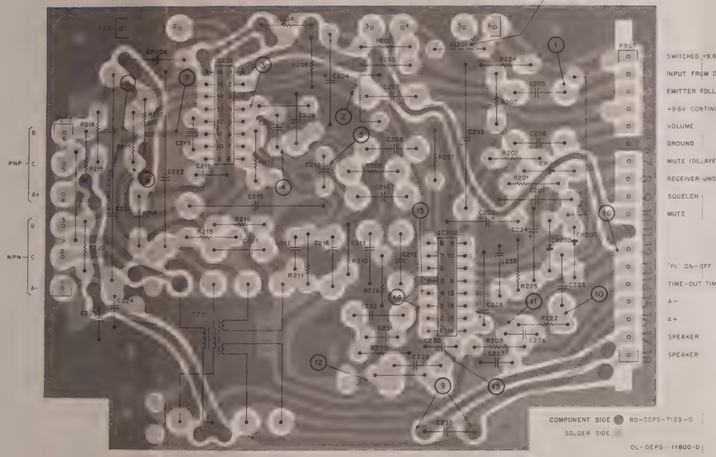
1. VERTICAL SENSITIVITY = 0.5 V/DIV.
2. HORIZONTAL DEFLECTION = 2 msec/DIV.
3. SQUELCH CONTROL FULLY CLOCKWISE (ON). NO EXTERNAL SIGNAL APPLIED.

*4 WAVEFORMS (15) AND (16) ARE DC COUPLED WITH ZERO AT BOTTOM, OTHERS AC COUPLED.

EPS-6797-A

SQUELCH CIRCUIT WAVEFORMS



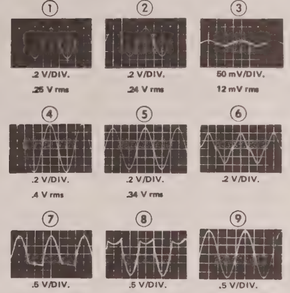


ALL AUDIO CIRCUIT OSCILLOSCOPE WAVEFORMS TAKEN UNDER FOLLOWING CONDITIONS:

1. VERTICAL SENSITIVITY SHOWN UNDER EACH WAVEFORM.
2. HORIZONTAL DEFLECTION = 25 msec/DIV.
3. SQUELCH CONTROL FULLY COUNTERCLOCKWISE (OFF): 1000 uV RF SIGNAL INPUT MODULATED WITH 1000 Hz TONE WITH ±3.3 kHz DEVIATION
4. VOLUME CONTROL SET FOR 9.0 V rms AT LOAD.
5. OUTPUT TERMINATED IN 8 OHM LOAD.

EPS-6798-O

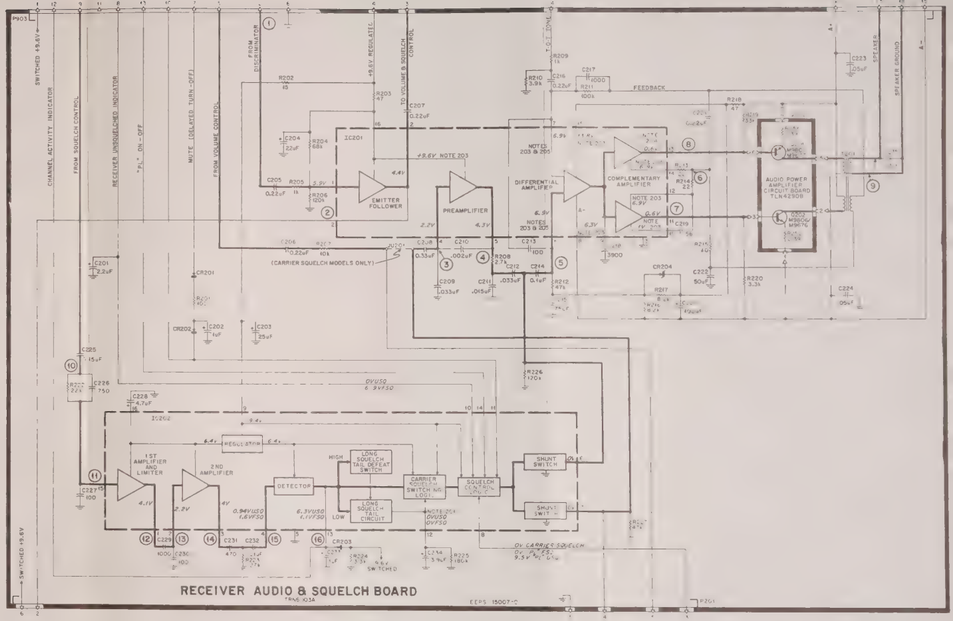
AUDIO CIRCUIT WAVEFORMS



DC VOLTAGE TABLE FOR IC'S

IC201				IC202			
PIN	VOLTAGE	PIN	VOLTAGE	PIN	VOLTAGE	PIN	VOLTAGE
1	5.8 V	9	8.3 V NOTE 202	1	4.1 V	9	9.4 V
2	4.4 V	10	1.8 V NOTE 202	2	2.2 V	10	0 V USQ 6.0-9.0 V FSQ
3	0 V	11	9.6 V NOTE 202	3	4.0 V	11	—
4	2.2 V	12	6.9 V NOTE 203	4	0.34 V USQ 1.6 V FSQ	12	0 V USQ 0 V FSQ NOTE 201
5	4.3 V	13	9.6 V NOTE 204	5	0 V	13	6.3 V USQ 1.1 V FSQ
6	6.9 V NOTES 203 & 205	14	6.9 V NOTE 203	6	0 V	14	—
7	6.9 V NOTES 203 & 205	15	12.8 V NOTE 200	7	0 V	15	2.2 V
8	A-	16	9.6 V NOTE 203	8	0 V CARRIER SQ 9.5 V "PL" USQ 0 V "PL" FSQ	16	6.4 V

EPS 6359-B



PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

Model TRN6003A Receiver Audio & Squelch Board
Schematic Diagram and Circuit Board Detail
Motorola No. PEPS-15007-C
7/29/74-NPC

22-15

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

ELECTRICAL PARTS LIST

IMPORTANT

USE ONLY THE FOLLOWING MOTOROLA PART NUMBERS WHEN ORDERING REPLACEMENT PARTS

TRN6003A Audio & Squelch Board PL-2878-O

		CAPACITOR, fixed: uF, ±10%, unl stated
C201	23-8476Z38P4	4.2 ±20%, 25 V
C202	23-8476Z38P0	1 ±20%, 35 V
C203	23-83210A01	2%+150-10%, 25 V
C204	23-8476Z40P10	22 ±20%, 15 V
C205	8-81813H11	0.22, 75 V
C206	8-81813H11	0.22, 75 V
C207	8-81813H11	0.22, 75 V
C208	8-81813H29	0.33, 50 V
C209	8-81813H04	.033, 100 V
C210	21-82187B27	.002, 100 V
C211	8-81813H32	.015, 100 V
C212	8-81813H04	.033, 100 V
C213	21-8442xB0n	100 pF ±5%, 500 V
C214	8-81813H0n	0.1, 100 V
C215	23-84081B03	75+150-10%, 15 V non-polar
C216	8-81813H11	0.22, 75 V
C217	21-84493B05	1000 pF, 200 V; NZ200
C218	21-82187B43	.0039, 100 V
C219	21-8340bD46	56 pF ±5%, 100 V; N150
C220	23-83210A08	100 ±20%, 25 V
C221	8-82905Q32	0.22, 50 V
C222	23-84081B01	50-100-10%, 25 V, non-polar
C223	21-82372C04	.05+80-20%, 25 V
C224	21-82372C04	.05+80-20%, 25 V
C225	8-81813H07	0.15, 75 V
C226	21-*48159	750 pF, 100 V
C227	21-82u10C58	100 pF, 100 V, N750
C228	21-8476Z30J7	4.7 ±20%, 25 V
C229	21-84493B05	1000 pF, 100 V, NZ00
C230	21-8442xB0n	100 pF ±5%, 500 V
C231	21-8442xB11	470 pF ±5%, 500 V
C232	8-83813M31	.01, 50 V
C233	8-81813H11	0.22, 75 V
C234	23-8476Z30J8	1.5 ±20%, 15 V
C235	8-82905G30	0.1, 50 V
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR201	48-83654H01	silicon
CR202	48-83654H01	silicon
CR203	48-83654H01	silicon
CR204	48-8225xC38	silicon, Zener type; 9.1 V ±0.45 V
		INTEGRATED CIRCUIT:
1C201	51-8426?A08	type Me708
1C202	51-8426?A09	type Me709
		CONNECTOR, receptacle:
P201		consists of n male contact terminals (Part No. 29K85494) mounted on edge of circuit board
P202		consists of n male contact terminals (Part No. 29K85594) mounted on edge of circuit board
P903		consists of 16 male contact terminals (Part No. 29C84028H01) mounted on edge of circuit board
		RESISTOR, fixed: ±5%, 1/4 W, unl stated
R201	6-129753	100 ±10%
R202	6-131177	15 ±10%
R203	6-129233	47 ±10%
R204	6-129299	68k
R205	6-127802	1k ±10%
R206	6-1-1446	120k
R207	6-129668	10k
R208	6-129707	2.7k
R209	6-127802	1k ±10%
R210	6-129819	3.9k
R211	6-129226	100k ±10%
R212	6-131527	47k
R213	6-124A09	22

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
R214	6-124A99	22
R215	6-129755	10 ±10%
R216	6-129983	8.2k
R217	6-129983	8.2k
R218	6-129233	47 ±10%
R219	6-129981	3.3k
R220	6-129981	3.3k
R222	6-129607	22k
R223	6-129886	27k
R224	6-129231	3.3k ±10%
R225	6-129229	180k ±10%
R226	6-128987	120k ±10%
R227	6-128902	47k ±10%
T201	24-84083B02	TRANSFORMER, AF: pri: split bifilar winding; res (each section) 0.25 ohms max. sec: res 0.8 ohms max. feedback: res 2 ohms max. NOTE: "Feedback side" coded with a paint mark

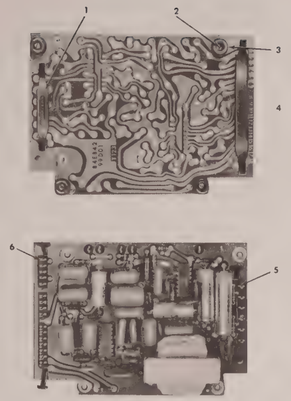
NOTE:

Replacement diodes must be ordered by Motorola part number only for optimum performance.

MECHANICAL PARTS LIST

TRN6003A Audio & Squelch Board PL-2877-O

CODE NO.	MOTOROLA PART NO.	DESCRIPTION
1	55B84300B02	HANDLE (short)
2	3513690S	LOCKSCREW, tapping: #4 x 5/16" (4 req'd)
3	42C84284B01	RETAINER, screw (4 req'd)
4	55B84300B01	HANDLE (long)
5	29C84028H02	PIN (short)
6	29C84028H01	PIN (long)



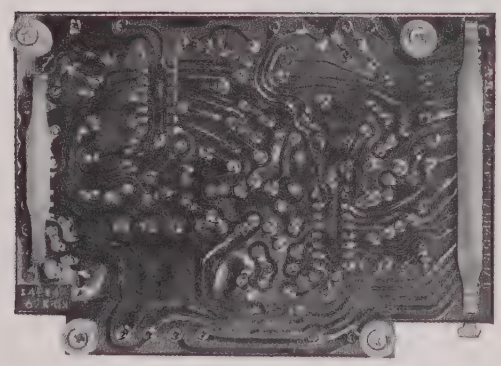
AEPS-7240-O

AUDIO & SQUELCH BOARD

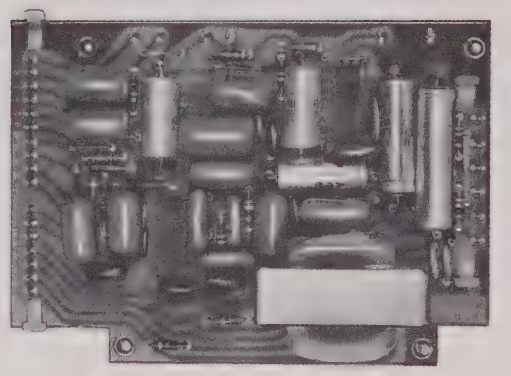
"MICOR" "SENSITRON" RECEIVER AUDIO & SQUELCH BOARD

MODEL TRN6003A

(FORMERLY MODEL TLN4310A)



TOP VIEW



BOTTOM VIEW

AEPS-6145-O

1. DESCRIPTION

This audio and squelch board performs two functions -- audio amplification and noise activated squelch. The audio portion of the board amplifies the audio output of the discriminator to drive an external speaker (the audio power amplifier transistors are mounted on a separate board). The squelch circuit eliminates the disturbing noise which would otherwise be heard at the speaker during invervals between received messages. Two integrated circuits are used for the audio amplification and squelch functions.

The circuitry is constructed on a single circuit board which is easily removed and replaced. All circuit plating is on one side of the board and all components are mounted on the opposite side. All external connections are made at three rows of pins, thus eliminating interconnecting wires. The set of eighteen pins at one end of the board mate to the control board of the radio set; the set of six pins at the opposite end make connections to the audio power amplifier transistors. For "Private-Line" tone-coded squelch operation, a PL decoder circuit board plugs directly into the one remaining set of six pins.

2. FUNCTIONAL OPERATION

a. General

The audio signal from the receiver discriminator is routed to the emitter follower stage on the audio and squelch board. The emitter follower output is routed out of the board to the VOLUME and SQUELCH controls. (In PL radios, the emitter follower output is also applied to a PL decoder.) Refer to Figure 1.

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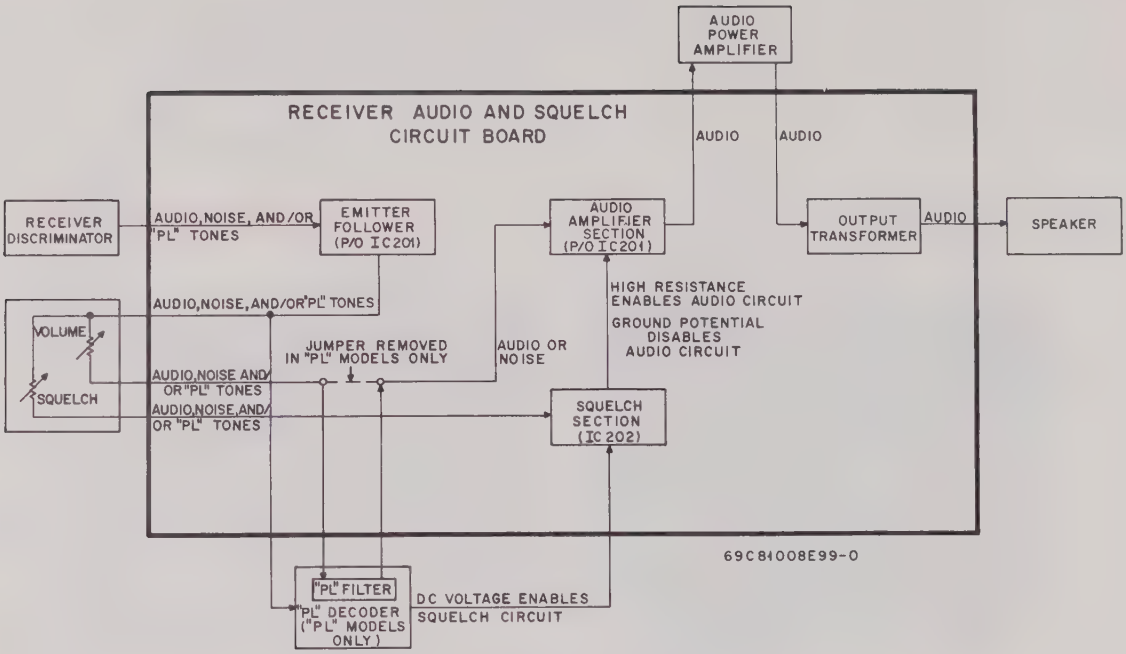

Figure 1.
Audio and Squelch Block Diagram

The signal returned from the VOLUME control is applied to the PL filter when applicable and then to the audio amplifier section for amplification. The amplified audio signal is used to drive an audio power amplifier which is mounted on a separate board for better heat sinking capability. The output of the audio power amplifier is applied to the output transformer to drive the external speaker.

The signal returned from the SQUELCH control is applied to the squelch section for noise squelch control. Squelch action is achieved by utilizing the inherent characteristic of a discriminator known as noise quieting. An input signal will cause more quieting of noise as the signal level is increased. When a desired level of noise quieting is reached, as determined by the squelch circuitry and the setting of the SQUELCH control, the audio portion of the board is enabled to allow a message to be heard. The squelch circuit disables the audio circuit by shunting two points in the audio signal path to ground.

Upon completion of a received message, audio shut-off is either immediate or automatically delayed 150 milliseconds, depending upon the signal level of the previously received rf carrier. A strong signal produces the immediate shut-off and prevents an annoying, loud "squelch tail" burst from being heard. Weak signals (signals that produce less than 20 dB noise quieting) produce the long shut-off delay and prevent a message from being chopped under "flutter" conditions. Since the received signal level must be low for the long turn-off delay to occur and the "squelch tail" level is comparable to that of the received signal, the "squelch tail" is not annoying.

For "Private-Line" tone-coded squelch operation, the output of the noise squelch portion of the circuit is disabled. Unsquelching of the audio circuit during "Private-Line" operation requires a dc input voltage from the PL decoder.

"Private-Line" tone-coded squelch radios may be PL disabled via an external PL disable switch. This places the receiver in carrier squelch operation.

b. Emitter Follower Circuit

The emitter follower circuit provides a low impedance output which isolates the high impedance discriminator output from the following squelch and audio circuitry. Refer to Figure 2.

The output of the discriminator is capacitively coupled to the emitter follower input at IC201-1 and may consist of noise, audio signals, and/or PL tones. The output of the emitter follower at

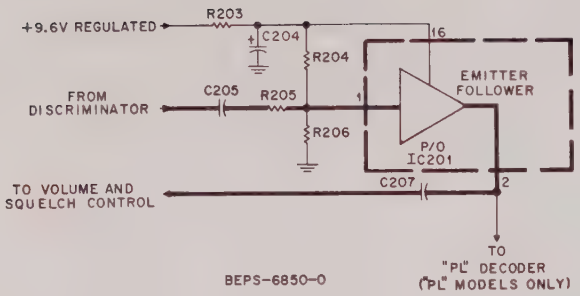

Figure 2.
Emitter Follower Circuit

IC201-2 is routed to (1) external VOLUME and SQUELCH controls through coupling capacitor C207 and (2) a PL decoder in "Private-Line" tone-coded squelch radios.

c. Audio Amplification Circuit

The signal from the VOLUME control is returned to the audio and squelch board at P903-5. Refer to Figure 3.

In "Private-Line" tone-coded squelch radios, jumper JU201 is removed to route audio to a PL filter on the PL decoder. Audio returned from this filter is free of PL tones, preventing the tone from being heard at the speaker. C206 and C208 prevent any dc potential from the audio channel from affecting the shunt switch.

The preamplifier amplifies the low level audio signal to provide the required drive to the differential amplifier. Negative feedback around the preamplifier is provided by C210 to attenuate audio signals above 3000 Hz. Further roll-off is provided by R207 and C209, and by R208 and C211. Capacitors C212 and C214 dc isolate the preamplifier output and the differential amplifier input from the squelch shunt switching.

The differential amplifier output provides drive for the complementary amplifier. Resistors R216 and R217 form a bias network that biases the differential amplifier at exactly one-half of the supply voltage. Capacitor C213 eliminates the effect of any transient voltage that may be applied to the differential amplifier.

Final audio amplification on the audio and squelch board occurs in the complementary amplifier. Its output provides drive for the audio power amplifiers which are mounted on a separate board. Complementary amplifier emitter resistors R213 and R214 are external to the IC due to heat dissipation requirements.

Audio returned to the audio and squelch board from the audio power amplifier transistors is applied to the output transformer primary windings. This transformer consists of four windings -- two input primaries, an output secondary, and a feedback secondary. The output secondary winding couples audio power to an external 8-ohm speaker which can be driven with up to 10 watts at less than 5% distortion. Negative feedback from the output transformer winding through C217 and across R210 gives 6 dB per octave de-emphasis (roll-off) to the audio which has been pre-emphasized 6 dB per octave in the transmitter. Below 300 Hz, feedback from R211 and across C216 increases giving low frequency de-emphasis. Resistor R221 supplies a light load to the audio power amplifier during certain situations such as the use of a headset. Capacitors C223 and C224 are rf bypass capacitors that shunt stray rf on the A+ and A- lines to ground.

d. Noise Activated Squelch Circuit

(1) Squelch Input Circuit

The input signal from the SQUELCH control may consist of noise, audio message, and/or PL tones. Refer to Figure 4.

An input shaping network precedes IC202 that passes high frequencies and attenuates low frequencies. Use of high frequencies eliminates the effect of voice and PL tones and results in more sensitive threshold squelch action.

The first amplifier and limiter is driven into limit by its input signal and prevents audio from squelching (disabling) the audio channel on voice signals. Amplified, limited noise is then passed through a coupling network to the second amplifier. This coupling network is also a high pass filter which further attenuates voice and PL tone signals to the second amplifier.

The second amplifier amplifies the noise signal and applies it through an RC coupling network to the detector. C231 and R223 form another high pass filter than attenuates the low frequencies. Capacitor C232 is used to produce a peak-to-peak detector action from the noise detector, and thus, generate twice the output voltage of a peak detector. This capacitor does not affect frequency response.

(2) Detector and Comparator Circuit

The detector output level is a function of received signal strength and the setting of the

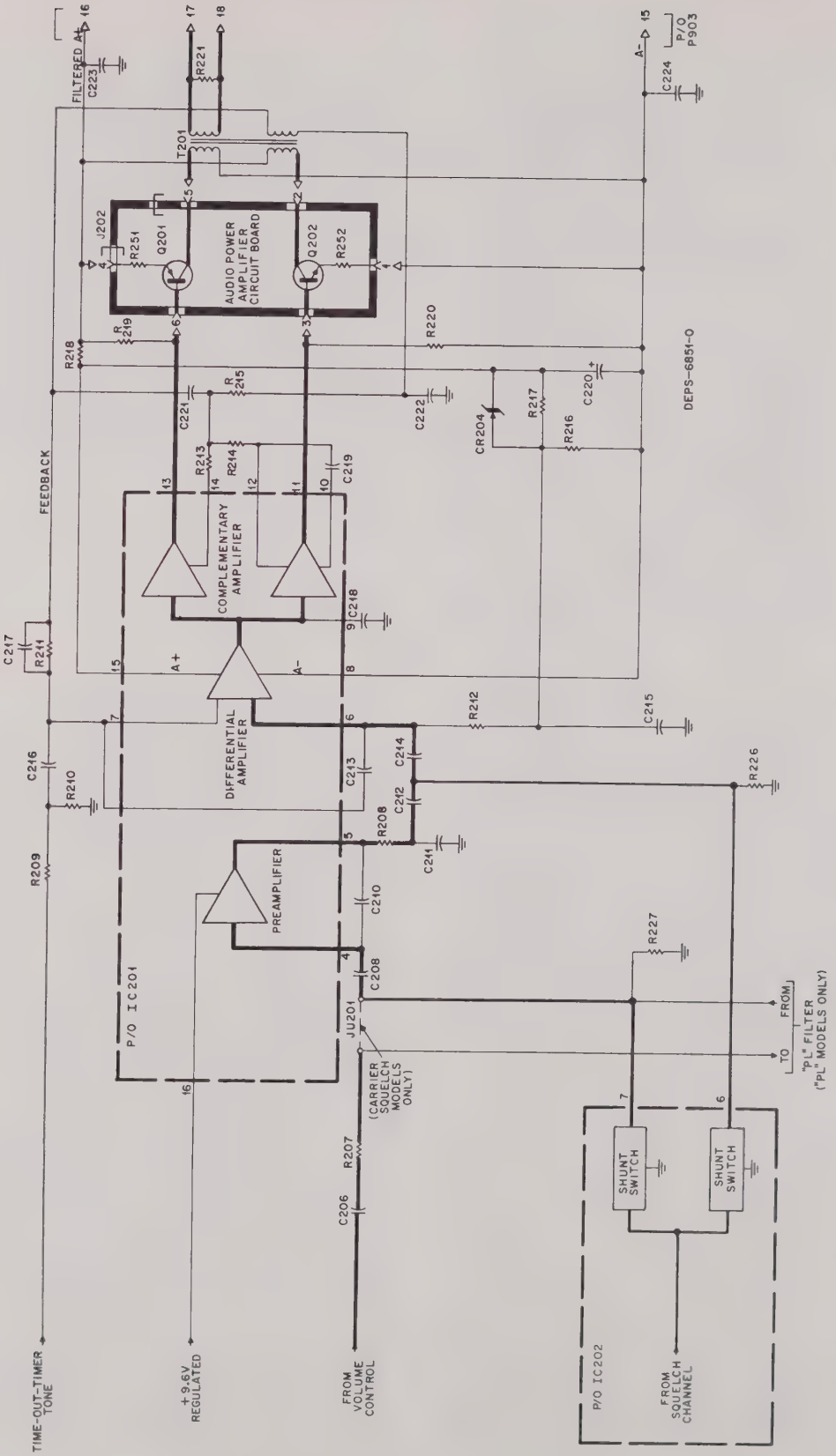

Figure 3. Audio Amplification Circuit

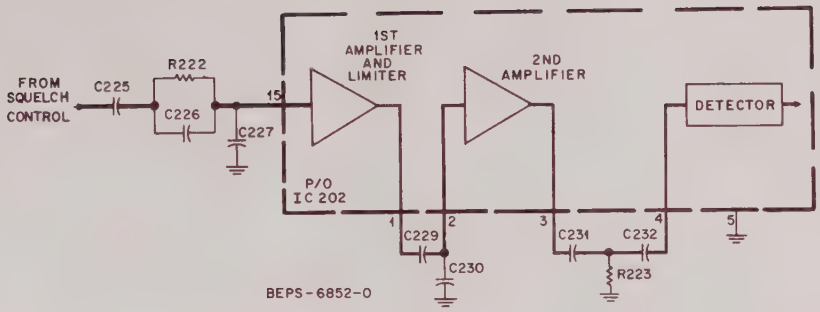

Figure 4.
Squelch Input Circuit

SQUELCH control. Refer to Figure 5. The detector develops the dc output voltage across filter capacitor C233. The lowest dc output voltage corresponds to a no signal input (maximum noise) condition. The output voltage increases as the received rf carrier signal level increases (noise decreases). The voltage may be used in PL radios to give an indication of on-channel usage even though the following noise squelch circuitry is inhibited. A voltage higher than approximately 2.8 volts dc indicates that the channel is being used, although not necessarily heard due to PL selection.

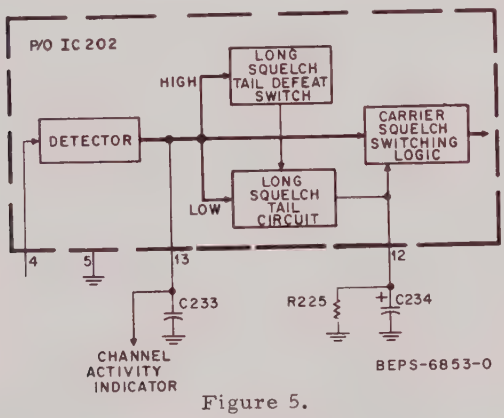

Figure 5.
Detector and Comparator Circuit

The primary function of the detector output, however, is the control of shunt switching. This is done as follows.

The detector output is applied to three squelch control circuits simultaneously:

- long "squelch-tail" circuit
- long "squelch-tail" defeat switch
- carrier squelch switching logic

With no received rf carrier signal (maximum noise condition), the long "squelch tail" circuit and long "squelch tail" defeat switch are "off" and the carrier squelch switching logic is "on". The audio channel is subsequently disabled unless the squelch control logic is overriden by other circuitry.

As the input signal level increases (noise decreases), the detector output voltage increases. A detector output voltage above 2.8 volts dc results in enabling of the long "squelch-tail" circuit. The long "squelch-tail" circuit produces a voltage at IC202-12 of 5.5 volts dc; this voltage causes the carrier squelch switching logic circuit to turn on and enable the audio channel. Capacitor C234 and resistor R225 provide a rapid rise, slow decay time constant to the voltage applied to the carrier squelch switching logic circuit. This permits a weak signal to immediately enable the audio channel, yet delays the audio channel shut-off if the signal is in a "flutter" condition. The voltage necessary to enable the carrier squelch switching logic is approximately 3.8 volts dc.

A voltage greater than 5 volts dc at this point (rf carrier signal level that produces 20 dB quieting, or better), turns on the long "squelch-tail" defeat switch. This disables the long "squelch-tail" circuit, and the 150-millisecond delay function. Audio channel disabling now occurs immediately after the rf carrier disappears.

(3) Squelch Output Circuit

The squelch control logic circuit directly controls the shunt switching. Refer to Figure 6.

The output of the squelch control logic circuit depends upon the output of the preceding carrier squelch switching logic circuit and three additional input functions. With no additional inputs and the carrier squelch switching logic

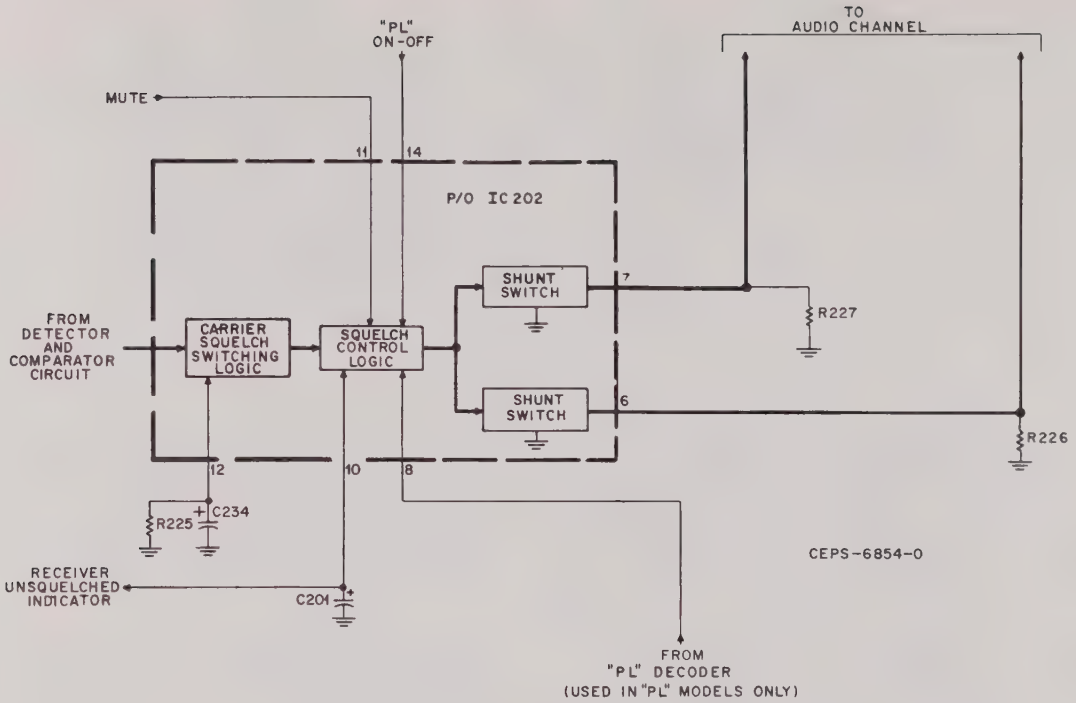

Figure 6.
Squelch Output Circuit

circuit "off", the squelch control logic circuit will turn off the shunt switches, allowing a message to be heard. If the carrier squelch switching logic is "on", the squelch control circuit will turn on the shunt switches, disabling the audio channel.

Two of the three additional functions that may affect squelch control logic output are associated with "Private-Line" tone-coded squelch operation. "PL" ON-OFF (IC202-14), which may be either shorted to ground or open, is connected to the "PL" ON-OFF switch in PL operation. When an open is present at pin 14 (OFF), a received signal with or without a PL tone will be heard from the speaker. When at ground potential (ON), the output of the carrier squelch switching logic circuit is inhibited. When the proper PL tone is received, a positive 9.5 volts dc from the PL decoder to IC202-8 turns "off" the squelch control logic circuit. This turns off the squelch shunt switches and allows a message to be heard.

The third additional function (mute) takes priority over all other squelch functions and mutes the audio channel via the squelch shunt switches when the radio set is in the transmit mode. While the transmitter is keyed, 9.6 volts dc is applied to P903-7 and coupled to IC202-11 through a fast charge, slow decay network. This network passes the muting voltage instantaneously to the squelch control logic circuit to turn on the squelch shunt switches and disable the audio channel. However, it takes approximately 40 milliseconds for the muting voltage at IC202-11 to decay once the muting voltage at P903-7 is removed. This delayed "unmuting" prevents a "squelch-tail" from being heard from the speaker. Special applications may require immediate mute and unmute functions. Provisions are made for this at P903-10. By routing the muting voltage to this point the delay network is bypassed and the audio channel may become enabled immediately upon removal of the muting voltage.

The squelch control logic output at IC202-10 supplies a digital output voltage to permit an indication that the receiver is unsquelched (audio channel enabled).

Audio disabling is performed by shunting two points of the audio circuit through a low impedance path to ground. When the two solid-state shunt switches are turned on, signals developed across resistors R227 and R226 are shunted to ground. This prevents any signals from being heard from the speaker. Conversely, when the shunt switches are "off", a message may be heard from the speaker. Both shunt switches are simultaneously either "on" or "off", and provide a total of 90 dB of attenuation to any signal in the audio channel when "on".

3. MAINTENANCE

a. General

This section of the manual provides maintenance shop type procedures for the audio and squelch board. It assumes that preliminary tests have already localized the trouble to this board. These bench tests include procedures for testing and troubleshooting, including integrated circuit check-out.

NOTE

The audio and squelch board must be installed in a radio set for testing to provide the necessary power and ground connections.

CAUTION

Care must be exercised if the radio is to be bench tested by the application of 12-volts directly to the radio transmitter and/or receiver stages. The power supply deck provides overvoltage and surge protection for these circuits; hence, an external power supply feeding the rf circuits directly must be well enough regulated to provide supply voltages that remain below harmful levels. Such a supply must provide a terminal voltage of 13.4 volts under full load with the transmitter keyed, but not exceed 16.5 volts (including transients) when switched to the no load (unkeyed) condition. Most power supplies will not meet this requirement; in fact, some SCR regulated power supplies have transient response that allows the output voltage to momentarily triple when switched from full load to no load. The following bench supplies are approved for testing the "Micor" radio when the power supply deck is bypassed:

Motorola S1303A or S1305A Regulated Power Supply.

Motorola T1261A Transistorized 24-Volt to 12-volt Converter driven by a Motorola T1012A Power Supply.

12-volt automotive battery with a Motorola T1012A Power Supply used as a battery charger.

b. Performance Tests

The preformance tests may be used for troubleshooting to isolate the point of abnormal operation. They may also be used after repair to assure that the board is operating properly before it is returned to service.

(1) Audio Amplification

(a) Specifications

The audio section of the audio and squelch board combined with the separate audio power amplifier transistors will provide at least 10 watts audio output at less than 5 per cent distortion at 3.3 kHz deviation (1 kHz modulated on-frequency signal applied to the radio set antenna receptacle).

(b) Procedure

1. Replace the speaker with an 8-ohm, 15-watt non-inductive resistor.

2. Set the SQUELCH control fully counterclockwise (unsquelched). "Private-Line" radios must also be PL disabled by placing the PL monitor switch in the OFF position.

3. Connect an rf signal generator to the radio set antenna receptacle and adjust it to the receiver frequency.

4. Adjust the signal generator for 1000-microvolt output, modulated with a 1000-Hz tone at ±3.3 kHz deviation.

5. Connect an ac voltmeter across the 8-ohm resistor.

6. Adjust the VOLUME control until 9.0 volts ac rms is read on the ac voltmeter (this represents 10 watts).

7. Measure distortion at 10 watts audio output power. It should be less than 5 per cent.

(2) Squelch Control

(a) Specifications

1. The squelch section of the receiver audio and squelch board shall enable the

audio section when an rf signal level greater than 6 dB noise quieting (one-half the discriminator output level with no signal input) is applied to the receiver with the SQUELCH control set at threshold. When the signal is removed from the radio set, the audio channel shall become disabled after approximately 150 milliseconds. When an input signal greater than that required for approximately 20 dB noise quieting is removed from the radio set, the audio channel shall become disabled immediately.

When the SQUELCH control is turned fully clockwise (tight squelch) an input signal that produces about 20 dB noise quieting shall be required to enable the audio channel.

The squelch section shall inhibit audio output when no input signal is received.

2. In "Private-Line" tone-coded squelch radios, the squelch section of the receiver's audio and squelch board shall perform as described in the preceding step 1. while the radio set is PL disabled. PL disable is accomplished by placing the PL monitor switch in the OFF position.

In PL operation, the squelch section shall inhibit audio output when the proper PL tone is not received, regardless of the input signal strength.

(b) Procedure

1. Carrier Squelch Radios

a. Turn the radio set on and adjust the SQUELCH control clockwise from the full counterclockwise position until the receiver just quiets (threshold squelch).

b. Measure the resistance of IC202-6 and -7 with reference to ground. Both pins should be less than 1000 ohms.

NOTE

Erroneous readings will be obtained in resistance measurements if the voltage between the ohmmeter probes exceeds approximately 5.0 volts dc.

c. Connect a signal generator to the radio set antenna receptacle and adjust it to the receiver frequency. Modulate the generator output with a 1000-Hz tone at ±3.3 kHz deviation.

d. Increase the signal generator output slowly until the radio set just unsquelches. Remove the modulation from the signal generator. Unsquelching should occur at a generator output that produces 6 dB noise quieting, or less.

e. Measure the resistances of IC202-6 and -7 with reference to ground. Both pins should be greater than 200,000 ohms.

f. Increase the signal generator output until approximately 12 dB noise quieting is obtained. Remove the rf signal from the radio set input either by turning off the signal generator or by using a relay in series with the signal generator output. A long "squelch-tail" should occur. If a calibrated, triggered sweep oscilloscope is available for measurement, the duration of the "squelch-tail" should be approximately 150 milliseconds as measured at the speaker.

g. Increase the signal generator output to produce 30 dB noise quieting. Turn off the rf signal and note the "squelch-tail" duration. It should be no more than a "click". The duration should be less than 10 milliseconds.

h. Turn the SQUELCH control fully clockwise (tight squelch).

i. Adjust the signal generator output level until the radio set just unsquelches. Unsquelching should occur at a generator output that produces approximately 20 dB noise quieting.

2. "Private-Line" Tone-Coded Squelch Radios

a. Disable PL operation by placing the PL monitor switch in the OFF position.

b. Perform previously described carrier squelch radio procedure.

c. Return the radio set to PL operation by placing the PL monitor switch in the ON position.

d. Vary generator output between minimum output and 1000 microvolt output while checking the resistances of IC202-6 and -7 with reference to ground. Both resistances should remain at less than 1000 ohms.

e. Modulate the on-frequency generator output with a PL tone for ±0.5 to ±1 kHz deviation and 1000-Hz tone for ±3.3 kHz overall deviation.

f. Increase the signal generator output slowly until the radio set just unsquelches. Unsquelching should occur at a generator output that produces 6 dB quieting, or less.

c. Troubleshooting

(1) Check Input Voltages

A malfunction in the audio and squelch operation may be due to the loss of dc input voltages which can be caused by this board or another section of the radio set. Since there are only three input voltages applied to this board, it is advantageous to verify their presence before beginning extensive troubleshooting.

P903-4	+9.6 V dc regulated in respect to chassis
P903-15	A- (approximately -13.6 V dc in respect to filtered A+ P903-16).
P903-16	Filtered A+ (approximately +13.6 V dc in respect to A-, P903-15).

(2) Isolating Defective Components

If tests indicate abnormal performance, a logical troubleshooting procedure should be followed to isolate the defective component efficiently. Results of performance tests usually localize the malfunction to one or two stages. The accompanying troubleshooting chart summarizes these results in a logical sequence. A few waveforms, voltage and resistance checks in the suspected circuit should readily isolate the defective component when compared with those on the schematic diagram.

(3) Troubleshooting Integrated Circuits

Integrated circuits (IC's) are very reliable components and should not be replaced until all checks have proven definitely that the IC is the defective component. Make sure that the external components in the circuit are normal. The IC's on the audio and squelch board may be checked by dc voltage measurement although signal tracing with an oscilloscope is preferred.

(4) Stage Gain Measurements

(a) Squelch Circuitry

This troubleshooting procedure may be used to isolate a squelch malfunction occuring before the detector to a specific stage. The test is performed by injecting an ac signal at the input to the squelch circuitry and noting results obtained with an ac voltmeter. Most accurate results are obtained by taking dB gain and loss measurements between points as illustrated in Figure 7. Individual point voltage checks may also be used to quickly verify proper squelch input circuitry operation but this is not an adequate test to prove the circuitry is defective (refer to the following table and Figure 7). Tolerance addition may cause increasing variation from the typical readings in the table as readings are taken further from the injected signal point.

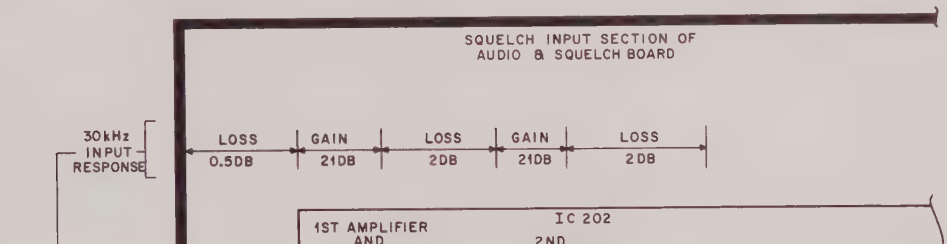

Figure 7.
Squelch Circuitry Stage Gain Measurements

The following procedure may be used for loss and gain or signal level measurements while injecting a 3 kHz or 30 kHz signal. In "Private-Line" tone-coded squelch radios, PL operation will not affect this test.

1. Turn the VOLUME control fully counterclockwise (off), or to a comfortable listening level, if desired.

2. Turn the SQUELCH control fully clockwise (squelched) and turn the radio set on.

3. Inject a 1000-microvolt, on-channel signal at the radio set antenna receptacle. This "quiets" the discriminator output and prevents erroneous test readings.

4. Inject a 3-kHz, 10-millivolt rms signal at the receiver audio & squelch board at P903-9.

5. Take loss and gain measurements or signal level measurements as required.

6. Repeat the preceding test using a 30 kHz signal in place of the 3 kHz signal in step 4.

(b) Audio Circuitry

AC voltage measurements and waveforms are given where applicable on the schematic diagram. Refer to this diagram for pertinent information when taking audio stage gain measurements.

AC VOLTMETER CONNECTED TO IC202-PIN	AC VOLTMETER READING WITH 3 kHz SIGNAL INPUT (mV)	AC VOLTMETER READING WITH 30 kHz SIGNAL INPUT (mV)
15	3.5	9.5
1	40.0	110.0
2	7.0	85.0
3	80.0	950.0
4	24.0	750.0

"PL" DECODER BOARD COMPONENT LOCATIONS

REF. SYM.	LOCATION
C801	A4
C802	A3
C803	A4
C804	A4
C805	A4
C806	B4
C807	B4
C808	B4
C809	B3
C810	A2
C811	B2
C812	B2
C813	A1
C814	B1
C815	B1
C816	B2
C817	B2
C818	A3
CR801	A3
CR802	B1
L801	B4
L802	B1
L803	B1
Q801	B3
Q802	A3
Q803	A3
Q804	A2
Q805	A1
Q806	A2
Q807	A4
R801	A4

REF. SYM.	LOCATION
R802	A4
R803	A4
R804	B4
R805	B4
R806	B3
R807	B3
R808	B3
R809	B3
R810	A4
R811	A3
R812	A3
R813	A2
R814	A2
R815	B2
R816	B1
R817	A1
R818	A1
R819	A1
R820	A1
R821	A1
R822	B2
R823	B2
R824	B2
R825	B4

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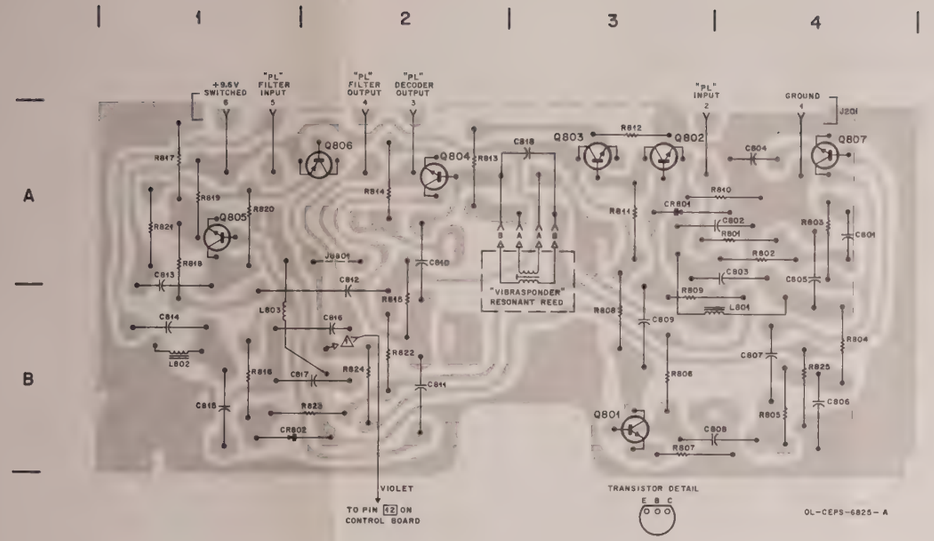

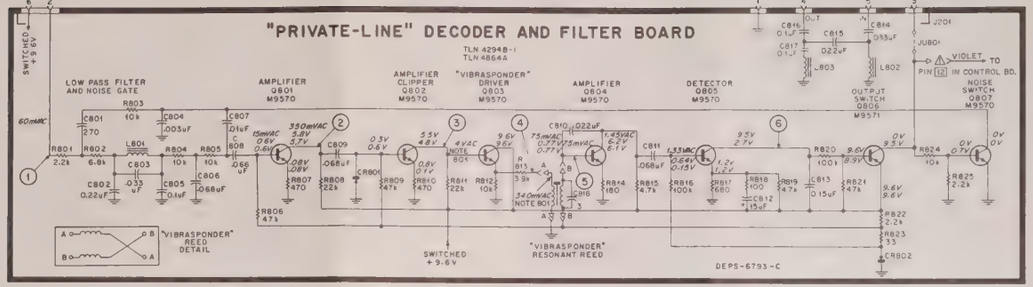

"PL" DECODER

801. DUE TO SQUARE WAVE CHARACTERISTICS SOME METERS RESPOND DIFFERENTLY. VOLTAGE SHOULD BE MEASURED WITH AN OSCILLOSCOPE.
802. AC VOLTAGE READINGS ARE RMS VALUES WITH 60 MILLIVOLTS "PL" TONE INPUT. USE HIGH IMPEDANCE (10 MEGOHM) AC VOLTMETER. MEASUREMENT MADE IN RESPECT TO CHASSIS GROUND.
803. DC VOLTAGE READINGS TAKEN WITH HIGH IMPEDANCE (11 MEGOHM) DC VOLTMETER. TOP VALUE IS MEASURED WITHOUT "PL" TONE. BOTTOM VALUE IS MEASURED WITH 60 MILLIVOLTS "PL" TONE INPUT. MEASUREMENT MADE IN RESPECT TO CHASSIS GROUND.
804. UNLESS OTHERWISE STATED: CAPACITOR VALUES ARE IN PICOFARADS.

EPS-6815-O

WAVEFORMS MEASURED UNDER FOLLOWING CONDITIONS:

1. VERTICAL SENSITIVITY SHOWN UNDER EACH WAVEFORM.
2. HORIZONTAL DEFLECTION = 5 msec/DIV.
3. WITH RECEIVER OPERATING PROPERLY:
   - A. INJECT 1000 uV RF CARRIER AT ANTENNA CONNECTOR.
   - B. MODULATE CARRIER WITH "PL" TONE. ADJUST MODULATION FOR WAVEFORM 1 I.E., 60 mV rms (170 mV P-P) AT J201-2.
4. RECEIVER NOT USED:
   - A. INJECT "PL" TONE AT J201-2.
   - B. ADJUST TONE LEVEL FOR WAVEFORM 1
5. OSCILLOSCOPE VERTICAL INPUT – AC.
6. OSCILLOSCOPE SYNC – INTERNAL.
7. MEASUREMENTS MADE IN RESPECT TO CHASSIS GROUND.

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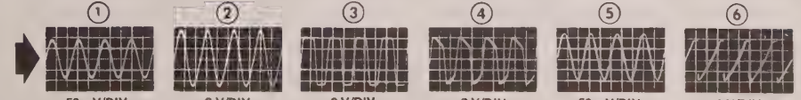
"PL" DECODER WAVEFORMS



PREVIOUS REVISIONS AND PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

Models TLN4294B and TLN4864A
Private-Line" Decoder
Schematic Diagram and
Circuit Board Detail
Motorola No. 63P81012E43-O
7/29/74-NPC

"PL" DECODER

REVISIONS

63P81012F43 C

CHASSIS AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
TLN4294B-1	C818	ADDED 21-83406D51, 3 pF	"VIBRASPONDER" RESONANT REED
TLN4864A		MODEL ADDED	

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

PARTS LIST

IMPORTANT

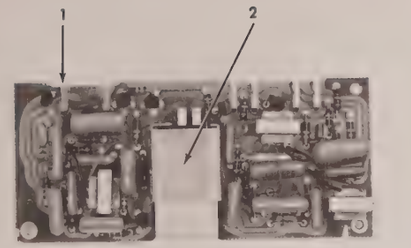
USE ONLY THE FOLLOWING MOTOROLA PART NUMBERS WHEN ORDERING REPLACEMENT PARTS

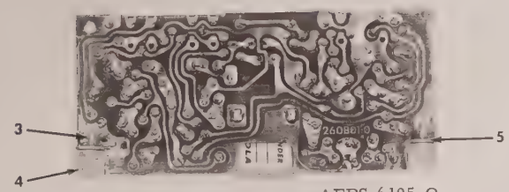
TLN4294B and TLN4864A "Private-Line" Decoders PL-1291-B

		CAPACITOR, fixed: uF ±10%; 50 V; unl. stated
C801	21-82187B38	270 pF
C802	8-82905G32	0.22
C803	8-82905G08	.033; 100 V
C804	21-82187B26	.003; 100 V
C805	8-83813H06	0.1; 100 V
C806	8-82905G04	.068; 100 V
C807	8-82905G01	.01
C808	8-82905G04	.068; 100 V
C809	8-82905G04	.068; 100 V
C810	8-82905G02	.022
C811	8-92095G04	.068; 100 V
C812	23-83214C02	15 ±20%; 25 V
C813	8-82905G31	0.15
C814	8-82905G08	.033; 100 V
C815	8-82905G02	.022
C816	8-82905G30	0.1
C817	8-82905G30	0.1
C818	21-83406D51	3 pF ±0.25 pF; 500 V; NPO
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR801	48-83654H01	silicon
CR802	48-83654H01	silicon
		COIL, RF: choke:
L801	24-84003A01	6 H
L802	24-84003A01	6 H (TLN4294B)
	OR	
	25-84461E01	6 H; shielded (TLN4864A)
L803	24-84003A01	6 H
		TRANSISTOR:
Q801 thru 805	48-869570	N-P-N; M9570
Q806	48-869571	P-N-P; M9571
Q807	48-869570	N-P-N; M9570
		RESISTOR, fixed, ±5%; 1/4 W; unl. stated
R801	6-128689	2.2k ±10%
R802	6-128687	6.8k ±10%
R803	6-129225	10k ±10%
R804	6-129225	10k ±10%
R805	6-219225	10k ±10%
R806	6-131527	47k
R807	6-129709	470
R808	6-129667	22k
R809	6-131527	47k
R810	6-129709	470
R811	6-129667	22k
R812	6-129225	10k ±10%
R813	6-129819	3.9k
R814	6-129431	180
R815	6-129669	4.7k
R816	6-124A97	100k
R817	6-129984	680
R818	6-129753	100 ±10%
R819	6-129669	4.7k
R820	6-124A97	100k
R821	6-131527	47k
R822	6-129804	2.2k
R823	6-124A13	33
R824	6-129225	10k ±10%
R825	6-128689	2.2k ±10%

NOTE:

Replacement diodes must be ordered by Motorola part number only for optimum performance.





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PARTS LIST

IMPORTANT

USE ONLY THE FOLLOWING MOTOROLA PART NUMBERS WHEN ORDERING REPLACEMENT PARTS

Mechanical Parts (TLN4294B and TLN4864A) PL-1292-A

ITEM	MOTOROLA PART NO.	DESCRIPTION
1	9-83011H01	TERMINAL, pin: female; 6 req.
2	42-84116B01	SOCKET & CLAMP ASSY
3	3-136905	SCREW, lock: No. 4 x 5/16"; 2 req.
4	42-84284B01	RETAINER, Nylon: 2 req.
5	7-84223B01	BRACKET, retainer

"PL" DECODER

Mechanical and Electrical Parts List
Motorola No. PEPS-6830-C
7/29/74-NPC

24-8

CONTROL BOARD COMPONENT LOCATIONS

REF. SYM.	LOCATION
C901	A1
C902	A1
C903	A2
C904	A1
C905	A1
C906	A1
C907	A1
C908	A1
C909	A4
C910	A2
C911	A3
C912	A4
C913	A3
C914	A7
C915	A5
C916	A4
C917	A3
C918	A8
C919	A7
C920	A8
CR901	A1
CR902	A1
CR903	A1
CR904	A1
CR905	A1
CR906	A1
CR907	A1
CR908	A1
CR909	A4
CR910	A4
CR911	A4
CR912	A4
CR913	A7
CR914	A6
CR915	A5
CR916	A6
CR917	A9
CR918	A9
CR919	A9
CR920	A6
CR921	A9
CR922	A8
JU901	A1
JU902	A1
JU903	A1
JU904	A4
JU905	A4
JU906	A6
JU907	A10
JU908	A6
K901	A6
K902	A6
L901	A2
L902	A3
PIN 1	A9
PIN 2	A7
PIN 3	A4
PIN 4	A3
PIN 5	A9
PIN 6	A6
PIN 7	A6
PIN 8	A6
PIN 9	A6
PIN 10	A8
PIN 11	A9
PIN 12	A9
PIN 13	A9
PIN 14	A8
PIN 15	A8
PIN 16	A9
Q901	A4
Q902	A4
Q903	A4
Q904	A5
Q905	A5
Q906	A9
Q907	A9
Q908	A7
R901	A4
R902	A4
R903	A4
R904	A4
R905	A4
R906	A4
R907	A4
R908	A5
R909	A5
R910	A7
R911	A5
R912	A5
R913	A6
R914	A9
R915	A10
R916	A10
R917	A8
R918	A8
R919	A10
R920	A9
R921	A9
R922	A8
R923	A7
R924	A7
R925	A7
R926	A7
R927	A7
R928	A9

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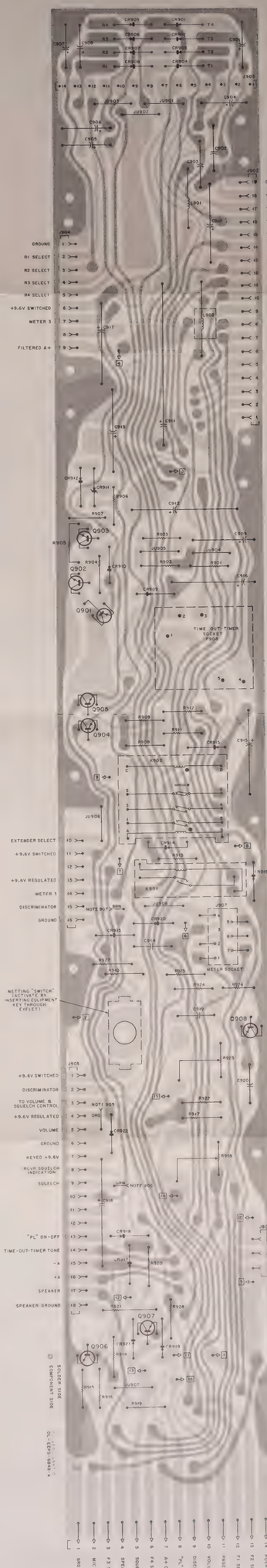
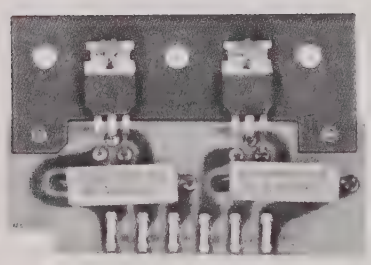
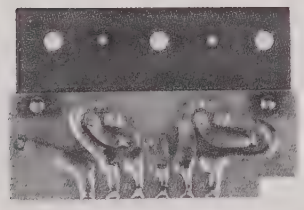


"MICOR" "SENSITRON" RECEIVER
AUDIO POWER AMPLIFIER
MODEL TLN4290B





1. DESCRIPTION

The audio power amplifier provides the required power to drive an 8-ohm speaker with ten watts of audio power at less than five percent overall distortion. Two complementary power transistors (N-P-N and P-N-P types) operating in class AB mode with two current limiting resistors develop this power. The audio drive from the audio and squelch board is routed to this board, amplified, and then returned to the audio and squelch board where it is applied to the audio output transformer.

The audio power amplifier consists of a single circuit board which is easily removed and replaced. All external connections are made at a single row of pins which eliminate interconnecting wires. All circuit board plating is on one side of the board while the components are mounted on the opposite side.

The aluminum transistor mounting plate is anodized with a thin, very tough material. This mounting plate provides excellent electrical insulation and thermal conduction properties between the transistors and the heat sink.

2. SERVICING

A malfunction on this circuit board is localized during radio set troubleshooting described in the radio set maintenance section of this manual. Isolation of the malfunction to a specific component on this board is performed by the following performance checks.

a. Performance Checks

Performance checks on this board consist of taking resistance readings as is done for any transistor or resistor. It should be noted, however, that many VTVM's and solid-state multimeters do not have sufficient voltage at the test probes to forward bias a transistor junction into conduction and, therefore, should not be used. An inexpensive volt-ohm meter of 1,000 to 20,000 ohms-per-volt sensitivity is sufficient for performing these checks.

NOTE

DO NOT INSERT METER TEST PROBE TIPS INTO FEMALE CONNECTORS ON THE BOARD. TO DO SO COULD CAUSE DAMAGE TO THE CONNECTORS AND

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Communications Division
SCHAUMBURG, ILLINOIS 60172

TRANSISTOR RESISTANCE MEASUREMENT CHECK
(BOARD REMOVED FROM RADIO - TRANSISTORS MOUNTED ON BOARD)

OHMMETER CONNECTIONS		PROPER RESISTANCE	
POSITIVE LEAD CONNECTED TO	NEGATIVE LEAD CONNECTED TO	P-N-P TRANSISTOR	N-P-N TRANSISTOR
Base	Emitter, then Base	Infinite	5-30 Ohms, both cases
Emitter, then Collector	Base	5-30 Ohms, both cases	Infinite
Collector	Emitter	Infinite	Infinite
Emitter	Collector	Infinite	Infinite

Failure to obtain these results indicates a defective transistor which must be replaced.

NOTE (Cont'd)

RESULT IN POOR ELECTRICAL INTERCONNECTION WITH THE AUDIO AND SQUELCH BOARD.

b. Transistor Replacement

Care must be exercised to prevent damage (such as a scratch) to the mounting plate anodizing at the transistor-mounting plate interface. Should the anodizing in this area become scratched, original performance can only be restored by the use of a new anodized plate. The plate can not be "repaired" by the use of any type of insulating washer without a loss in thermal conduction capability.

Factory replacement transistors are supplied with preformed leads to properly fit onto the aluminum mounting plate and circuit board. A new compression washer is also included.

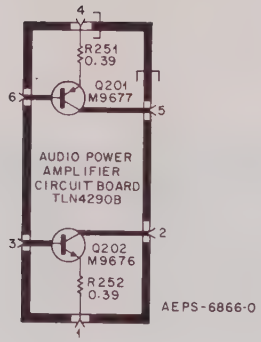
(1) Apply a thin, even coat of silicon grease to the metallic area of the transistor.

(2) Mount the transistor using the new compression washer. Do not solder leads at this time. Tighten the transistor mounting screw to 6 inch-pounds.

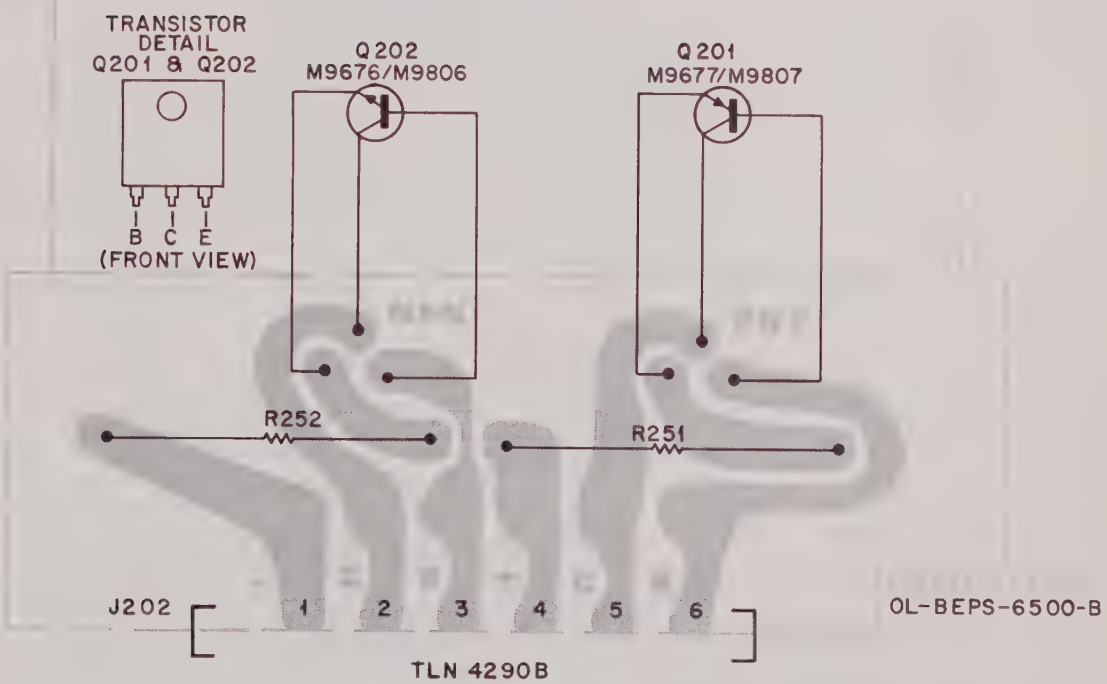
NOTE

Do not damage the transistor by over tightening the mounting screw. If no accurate method of measuring torque is available, tighten the mounting screw until it just "touches" the compression washer. Then turn the mounting screw 1/4 turn more.

(3) Solder transistor leads to printed circuit board.

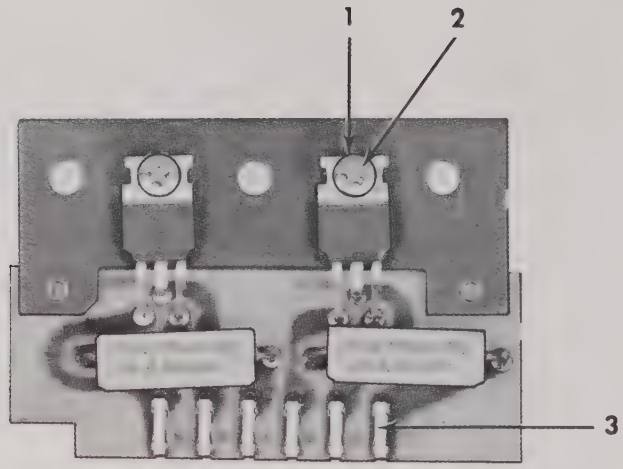


AUDIO POWER AMPLIFIER



AUDIO POWER AMPLIFIER

Audio Power Amplifier
Schematic Diagram and
Circuit Board Detail
Motorola No. 63P81012E39-A
7/29/74-NPC



AEPS-6502-O

PARTS LIST

IMPORTANT

USE ONLY THE FOLLOWING MOTOROLA PART NUMBERS WHEN ORDERING REPLACEMENT PARTS

Mechanical Parts List PL-1062-A

CODE NO.	MOTOROLA PART NO.	DESCRIPTION
1	4B84180C01	WASHER, shoulder
2	3S129841	SCREW, machine: No. 4-40 x 1/4"; incl. lockwasher
3	9B83011H01	PIN, female

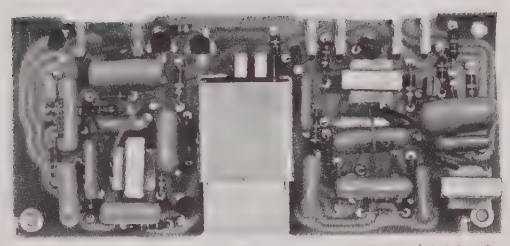
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
TLN4290B Audio Power Amplifier		PL-1061-A
J202		CONNECTOR, receptacle: c/o; 9B83011H01 PIN, female; 6 req'd
		TRANSISTOR: (SEE NOTE)
Q201	48R869677	P-N-P; type M9677
Q202	48R869676	N-P-N; type M9676
		RESISTOR, fixed: ±10%; 3 W: unl stated
R251	17D82177B49	0.39
R252	17D82177B49	0.39

NOTE:

Replacement transistors must be ordered by Motorola part number only for optimum performance.

"PRIVATE-LINE" DECODER

MODEL TLN4294B



AEPS-6103-O

TECHNICAL CHARACTERISTICS

FREQUENCY DETERMINING DEVICE	"Vibrasponder" Resonant Reed
"PL" TONE FREQUENCY	Selected from 67-210 Hz range
TONE ACCURACY	±0.15%
TONE BANDWIDTH	Approximately 1 Hz
TONE SENSITIVITY	0.25 volt ac rms reed drive
OUTPUT	9.5 volts dc switched
POWER REQUIREMENT	9.6 volts dc @15 milliamperes

1. DESCRIPTION

The "Private-Line" (PL) decoder provides a dc output voltage to unsquelch the receiver's audio section only when the proper PL tone is received. The decoder will respond only to a specific, continuous low-frequency tone from a transmitter in the same "Private-Line" network. A "Vibrasponder" resonant reed is the frequency determining device in the decoder, giving it accuracy of 0.15% (less than one cycle). Any other PL tone (tones from other PL networks on the same carrier frequency) will not activate the decoder and those messages will not be heard.

This solid-state PL decoder is constructed on a plug-in circuit board which is easily removed and replaced. Components are mounted on the opposite side from the circuit plating.

2. FUNCTIONAL OPERATION

a. General (Refer to Figure 1)

(1) "PL" Tone Present

With a PL tone present on the input signal to the decoder, the PL filter passes low frequency

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Figure 1.
"PL" Decoder Block Diagram

PL tones and attenuates voice and noise signals above 300 Hz. The noise switch shorts out high frequency noise signals. The tone from the PL filter is amplified by the PL amplifier and limited to a fixed level by the amplifier/clipper. The tone is applied to the "Vibrasponder" resonant reed which vibrates when the tone is the same frequency as the reed's resonant frequency. When the reed is vibrating, the device acts as a transformer and couples the tone from primary to secondary. The tone is amplified in the next stage and applied to a detector. When a tone is present, the detector develops a dc output which activates the output switch. When the output switch is activated, 9.5 volts is present at its output to enable the audio circuits. The output also activates the noise switch.

The separate audio filter which is located on the PL decoder board is a high pass filter which allows voice signals above 300 Hz to pass but blocks PL tones. This filter is connected in series with the audio signal path in "Private-Line" radios to prevent the PL tone from being heard in the speaker.

(2) "PL" Tone Absent

When no PL tone is present, or a tone other than that required to activate the reed is present, no signal is coupled through the "Vibrasponder" resonant reed. No detector output is developed, thus the output switch is off. The output voltage is 0 volts at this time which inhibits the squelch circuit to prevent an audio output to the speaker. The noise switch is off at this time which allows high frequency noise to bypass the PL filter. The presence of high frequency noise desensitizes the amplifiers and acts as an "anti-falsing" feature to prevent a random low-frequency noise signal from activating the resonant reed.

b. Decoder Input Circuits (Refer to Figure 2)

The receiver discriminator output signal is routed through an emitter follower stage on the receiver audio & squelch board. The emitter follower output is applied as the input to the PL decoder. The signal consists of noise only when no carrier signal is being received. With a carrier signal input to the receiver, the noise is reduced and voice audio or voice audio and PL tone added.

These input signals are routed through the low pass filter and noise gate circuit. A receiver input signal that is modulated ±0.5 kHz with PL tone produces a nominal 60 millivolts rms signal at the input to the decoder. The low pass filter consisting of L801, C802, C803 and C805 attenuates sharply all signals above 300 Hz. Thus, voice and noise signals above 300 Hz are blocked, but PL tones are passed. High pass filter C801, R803, and C807 presents a parallel path for high frequency noise whenever the decoder is not activated. This condition is desirable so that low frequency noise (only) will not falsely activate the decoder. When the proper tone has been received and the decoder is activated, noise switch Q807 acts as a short and grounds all high frequency signals before they reach amplifier Q801.

c. Input Amplifier Circuits (Refer to Figure 3)

Amplifier Q801 amplifies noise and PL tone signals which are coupled to amplifier/clipper Q802. Diode CR801 and the base-emitter junction of Q802 limit both the positive and negative swing of the signal to a maximum amplitude. The amplified output of Q802 provides a constant amount of drive even though the amount of PL tone deviation from various transmitters is not constant. It also limits the noise signals to prevent oversensitivity to noise signals which could falsely operate the

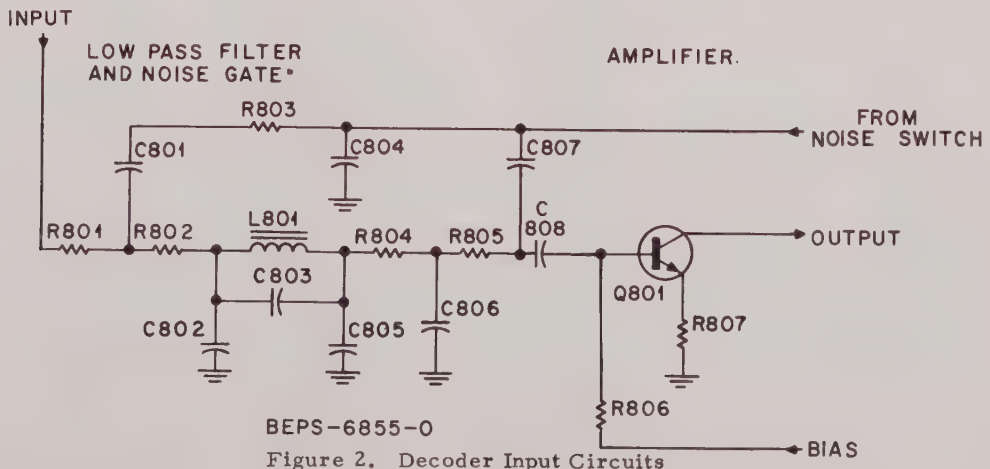

Figure 2. Decoder Input Circuits

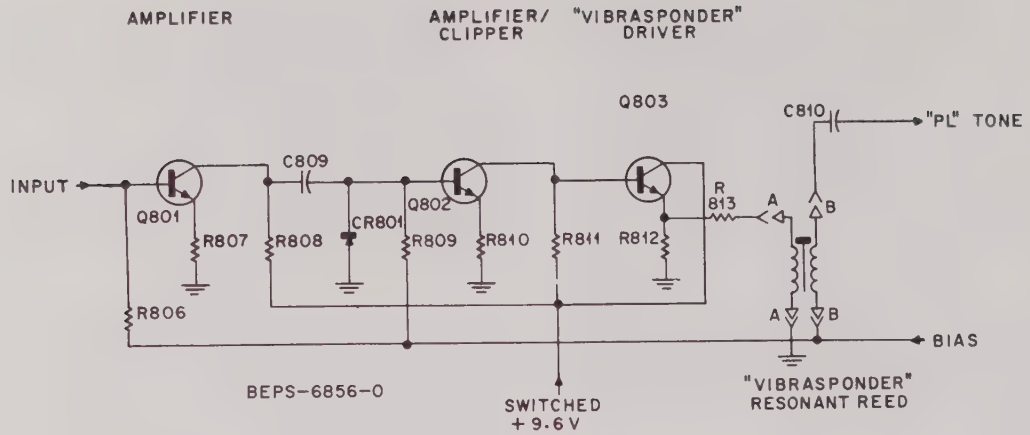

Figure 3. Input Amplifier Circuits

"Vibrasponder" resonant reed. "Vibrasponder" driver Q803 operates as an emitter follower to provide current drive to the low impedance "Vibrasponder" resonant reed.

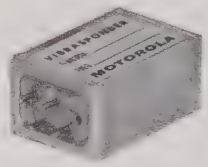

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Figure 4.
"Vibrasponder"
Resonant Reed

d. "Vibrasponder" Resonant Reed

The "Vibrasponder" resonant reed is the frequency determining device of the decoder. When the input tone from the "Vibrasponder" driver is the same frequency as the reed's resonant frequency, the reed vibrates. At resonance, the reed acts as a high Q transformer coupling energy from the primary to the secondary winding. At all other frequencies, the reed will not vibrate and no energy is coupled to the secondary winding. The reed is a precision built device consisting of a tuned cantilever reed of special steel mounted on a rugged base with a coil and permanent magnets. The entire assembly is spring-mounted and hermetically sealed in a metal housing to insure long life at peak performance under all types of conditions. Its design eliminates the need for servicing throughout its useful life. The plug-in unit is easily removed and replaced. The reed is sensitive to within 1 Hz of its resonant frequency. Specific tones in the 67 to 210 Hz range are used.

e. Output Circuit (Refer to Figure 5)

When the proper PL tone is applied to the reed, it develops a sinusoidal wave output at its resonant frequency. This sinusoidal wave is

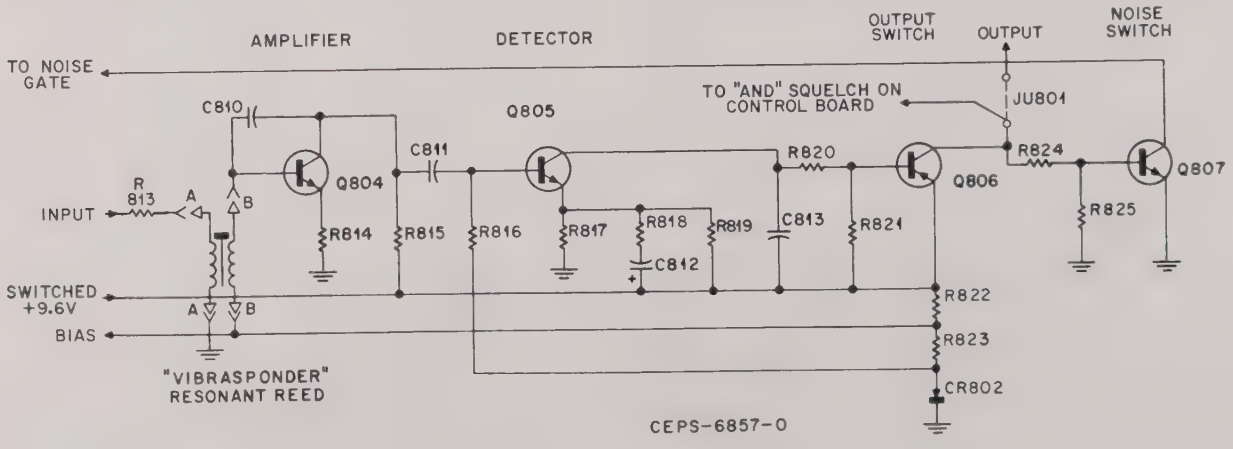


Figure 5. Output Circuit

"PL" DECODER

amplified by Q804. Negative feedback through C810 maintains the sinusoidal waveform. The amplified signal is coupled to detector Q805 which converts the signal to a dc potential. Q805 is cut off with its collector voltage of 9.6 volts until the tone is applied. With tone applied, the positive most portion of the sinusoidal wave is clamped at approximately 0.6 volt. The positive swing of each cycle causes momentary conduction of Q805 and the collector voltage drops to near zero volts. C813 charges during the conduction period and discharges through R820 and R821 to develop a filtered dc potential which forward biases output switch Q806. With Q806 activated, 9.6 volts is gated to the output which unsquelches the receiver. Noise switch Q807 is also activated which places a short across the noise gate as explained in paragraph (b).

f. Audio Filter

Audio and PL tone from the VOLUME control are routed through an audio filter consisting of C814-C817 and L802 and L803. The filter is electrically separate from the decoder but physically mounted on the same board. This filter is a high-pass type which blocks the PL tone and passes the audio to the audio & squelch board.

g. "AND" Type Squelch

In "AND"-type squelch operation, the PL sensitivity is variable. The level is set by adjusting the squelch (SQ) control located on the control board. The radio set is converted from standard PL operation to "AND"-type squelch operation by cutting jumper JU801 on the PL decoder board. For a detailed explanation of the "AND"-type squelch circuit, refer to the Control Board section of this manual.

3. MAINTENANCE

a. Recommended Test Equipment

(1) Motorola S1318A, S1319A, S1320A, or S1321A RF Signal Generator. This solid-state unit provides receiver rf carrier signals.

(2) Motorola SLN6221A "PL" Tone Generator and "Vibrasender" resonant reed on the same frequency as the "Vibrasponder" resonant reed of the decoder. An audio signal generator may be used if it is accurately set to the decoder frequency. However, to obtain the accuracy necessary, the frequency should be adjusted while the signal is measured on a frequency counter.

(3) Motorola Solid-State Oscilloscope for tone signal measurement. Some measurements may be taken with a high impedance ac voltmeter.

(4) Motorola Solid-State DC Multimeter for dc voltage measurements.

CAUTION

Care must be exercised if the radio is to be bench tested by the application of 12-volts directly to the radio transmitter and/or receiver stages. The power supply deck provides overvoltage and surge protection for these circuits; hence, an external power supply feeding the rf circuits directly must be well enough regulated to provide a terminal voltage of 13.4 volts under full load with the transmitter keyed, but not exceed 16.5 volts (including transients) when switched to the no load (unkeyed) condition. Most power supplies will not meet this requirement; in fact, some SCR regulated power supplies have transient response that allows the output voltage to momentarily triple when switched from full load to no load. The following bench supplies are approved for testing the "Micor" radio when the power supply deck is bypassed:

Motorola S1303A or S1305A Regulated Power Supply.
Motorola T1261A Transistorized 24-Volt to 12-Volt Converter driven by a Motorola T1012A Power Supply.
12-Volt automotive battery with a Motorola T1012A Power Supply used as a battery charger.

b. Performance Tests

A 0.25-microvolt rf carrier signal modulated ±0.5 kHz with PL tone should unsquelch the receiver. This can be checked as follows:

(1) Connect the rf signal generator to the antenna receptacle of the radio set. Set the signal generator to the receiver carrier frequency, then set the output to minimum.

(2) Modulate the signal generator output ±0.5 kHz with a PL tone of the frequency stamped on the "Vibrasponder" resonant reed. The tone can be generated with a Motorola SLN6221A PL Tone Generator and a "Vibrasender" resonant reed. The "Vibrasender" reed from the PL encoder may be used if it is the proper frequency.

(3) Also modulate the signal generator with an audio tone in the 300 to 3000 Hz range at ±3.3 kHz.

(4) Increase the output of the signal generator until the receiver unsquelches and the audio tone is heard on the speaker. No more than 0.25 microvolt should be required to unsquelch the receiver.

c. Troubleshooting

If the PL decoder does not operate, or operates improperly, the following hints may be helpful in locating the malfunction.

(1) Testing the "Vibrasponder" Resonant Reed

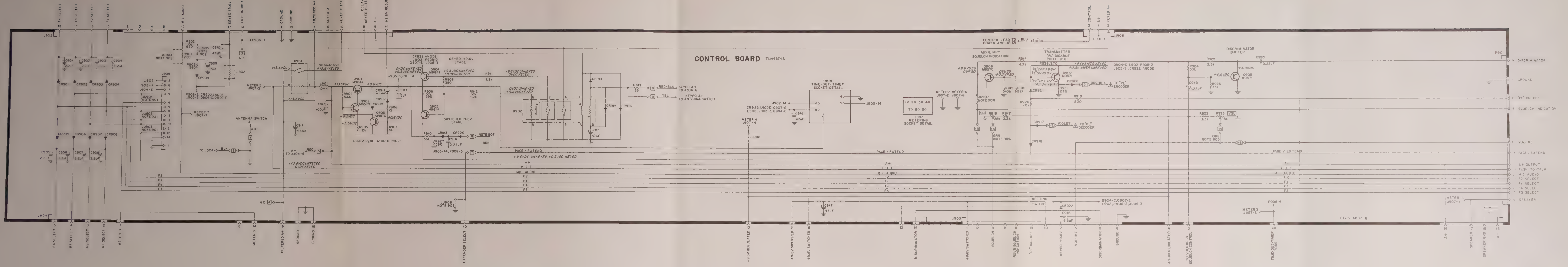
One of the first tests should be a check of the "Vibrasponder" resonant reed. Inject a 340 millivolt rms PL tone of the proper frequency directly to the primary of the reed. Use an oscilloscope or ac voltmeter to check the output across the secondary of the reed. Approximately 75 millivolts rms should be measured. If the reed is good, continue with other decoder tests.

(2) Decoder Testing

To test the decoder, inject a 1000-microvolt carrier signal into the receiver. Adjust PL modulation for 60 millivolts rms tone signal at the input to the decoder (test point (1) on the schematic diagram). If the PL tone is injected directly into the decoder for testing, an rf carrier signal should be injected into the receiver to quiet the receiver noise. Otherwise, noise and PL tone will both be present and will produce erroneous readings.

With 60 millivolts PL tone input, measure signal and dc voltages at various points in the decoder to isolate the trouble. Typical values for a normally operating decoder are given on the schematic diagram. Some waveforms are not sinusoidal and should be measured with an oscilloscope. Most ac voltmeters are calibrated to read accurately only for sinusoidal signals.

If under normal operating conditions, the PL tones are heard with the speaker audio, the high pass filter on the decoder board should be checked.



CONTROL BOARD

901. JU901, JU902 & JU903 OUT ON 8-FREQUENCY RADIOS.
902. SEE AUDIO SENSITIVITY TABLE.
903. JU906 OUT FOR EXTERNAL EXTENDER SELECT (MOBILE).
904. JU907 OUT FOR EXTERNAL SQUELCH CONTROL (MOBILE).
905. ORG LEAD TO PIN 16 FOR EXTERNAL VOLUME CONTROL (MOBILE), OR TO PIN 15 FOR INTERNAL VOLUME CONTROL.
906. GRN LEAD TO PIN 13 FOR EXTERNAL SQUELCH CONTROL (MOBILE), OR TO PIN 14 FOR INTERNAL SQUELCH CONTROL.
907. BRN LEAD TO PIN 7 FOR EXTERNAL EXTENDER SELECT (MOBILE), OR TO PIN 6 FOR PAGE.
908. ALL VOLTAGES MEASURED WITH RESPECT TO CHASSIS GROUND.
909. UNLESS OTHERWISE STATED, CAPACITOR VALUES ARE IN PICOFARADS.
910. VOLTAGES SHOWN AT BASE AND COLLECTOR OF Q907 ARE WITH THE TRANSMITTER KEYED.

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AUDIO SENSITIVITY

DESIRED MIC AUDIO SENSITIVITY	REQUIRED CONNECTIONS
0.36 V FOR ±3.5 kHz DEVIATION	JU904 OUT & JU905 IN. C408 AS SHOWN IN SOLID LINES.
0.22 V FOR ±3.5 kHz DEVIATION	JU904 OUT & JU905 IN. C408 AS SHOWN IN DASHED LINES.
0.165 V FOR ±3.3 kHz DEVIATION	JU904 IN & JU905 OUT. C408 AS SHOWN IN SOLID LINES.
0.100 V FOR ±3.3 kHz DEVIATION	JU904 IN & JU905 OUT. C408 AS SHOWN IN DASHED LINES.

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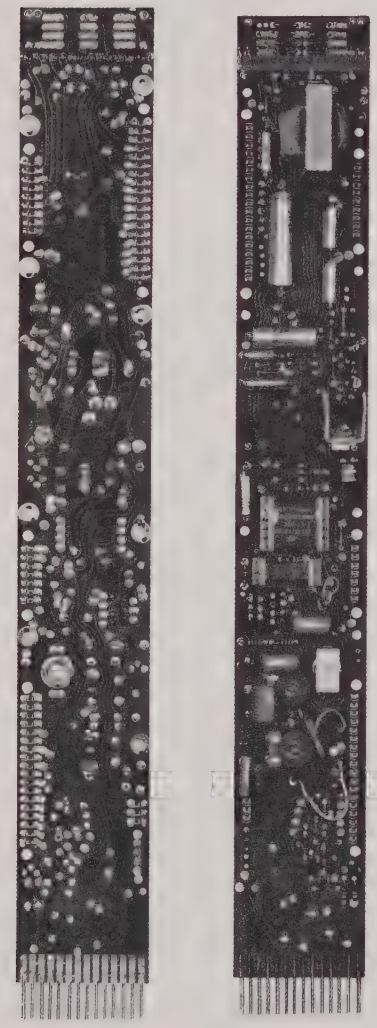
PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

Model TLN4574A Control Board
Schematic Diagram
Motorola No. 63P81013E54-B
7/29/74-NPC

CONTROL BOARD

CONTROL BOARD

MODEL TLN4574A



TOP VIEW BOTTOM VIEW

AEPS-6831-O

TECHNICAL CHARACTERISTICS

INPUT VOLTAGE	10.5 to 16.5 volts
REGULATED OUTPUT VOLTAGE	9.1 to 10.1 volts
REGULATION	±100 millivolts
TEMPERATURE RANGE	-30 to +65°C
MAXIMUM REGULATED CURRENT	350 milliamps (automatic cutback if current exceeds this value)

1. DESCRIPTION

The control board provides the following functions:

- Power distribution and filtering.
- A 9.6-volt regulator.
- Push-to-talk switching and sequencing.
- "AND" type squelch and transmitter PL disabling.
- Interconnection between circuits of the radio set.
- Netting
- Frequency selection routing for multi-frequency radios.
- Interconnections for options (Time-Out Timer, eight frequency operation, etc).
- Metering

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Receptacles on the control board mate with pins on the transmitter and receiver circuit boards to distribute desired functions from outside the radio and from board to board inside the radio. The double sided board routes the signals and eliminates the need for most wires. The few wires used, are terminated in removable female pin tip connectors to mate with pins in the circuit board. Additional pins and empty holes in the board are provided for connecting accessory items. The front of the board terminate in a row of 14 male pins. These mate with the connector board. The connector board is an interface between the cable connector, control board, spark gap, transient filter and the power supply boards.

2. CIRCUIT OPERATION

a. Power Distribution and Filtering
(Refer to Figure 1)

Power is applied to the radio via the input connector P1. A+ is applied to pin 2 and A- is applied either to pins 1 or 3 (depending on which input voltage is used). Power is then routed, via discrete wires, to the power supply. The power supply regulator filter board output is the power source for the entire radio set. This board is a high end regulator that limits the voltage at the control board and rf power amplifier to 16.5 volts maximum. Two push-on terminal leads (#22 blk A- and Red A+) route unfiltered A+ and ground from the regulator board to the control board for additional filtering on the control board. This is accomplished by a 10 mH choke (L901) and a 500 uF capacitor (C911). Filtered A+ is then routed to the exciter, receiver, audio and squelch board and to reed switch K901. Reed switch K901 is closed when the P-T-T function is activated.

A control socket mounted on the control board permits a portable test set to check speaker audio at pin 1 and microphone audio or microphone dc at pin 7. Pin 5 monitors push-to-talk keying. If the push-to-talk function is not present, pin 5 will measure A+ input voltage. Pin 3 is omitted, +9.6 V connects to pin 4 (not directly measurable on test set) and pins 6 and 2 are chassis ground.

b. 9.6-Volt Regulator Circuit
(Refer to Figure 2)

Filtered A+ is applied to a 9.6-volt regulator circuit which provides regulation within ±100 millivolts for input voltages from 10.5 to over 16.5 volts. Automatic shutdown occurs if the output becomes overloaded or shorted.

The regulated output voltage is developed across Zener diode CR911, diode CR912 and the resistors in the base of output voltage sensor Q903. Since the voltage across the Zener diode is constant, almost the entire variation is applied to the base of Q903. It amplifies and inverts the variation, developing a negative feedback which is applied to the base of driver Q902. Driver Q902, in turn, controls the base current drive to series regulator Q901. Total load current flows through Q901 which acts as a controlled series resistance in response to drive from Q902. The complete negative feedback path causes the resistance of Q901 to counteract output voltage variations.

Drive to Q901 is relatively independent of input voltage since drive to Q903 is derived from the regulated output. Therefore, its collector current and the drive to Q902 are also derived from the regulated output.

Diode CR910 protects the circuit from extreme overload such as a short. If the 9.6-volt output is shorted or overloaded, it drops toward zero. Q903 would tend to cut off. However, when the output voltage drops .6 volt below the voltage at the collector of Q903, diode CR910 conducts. This occurs if the output current exceeds 350 milliamps (normal load current is approximately 170 milliamps, plus the current

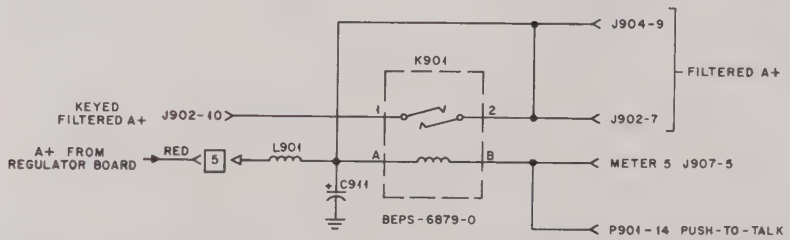

Figure 1.
Power Distribution & Filtering Circuit

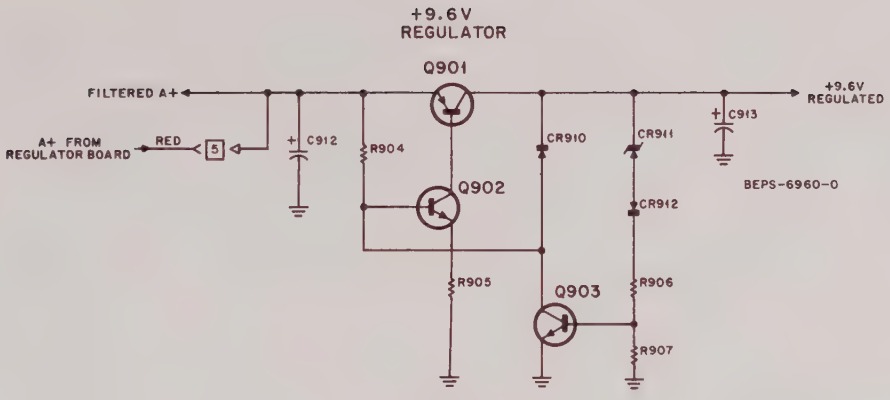

Figure 2.
9.6 Volt Regulator Circuit

for any optional accessory items operating from 9.6 volts). This action limits the amount of forward bias on Q902, and the emitter resistor limits maximum collector current of Q902. Since collector current of Q902 is the base drive current for Q901, it is limited to this same low value and Q901 shuts down.

The output voltage of the regulator is a nominal 9.6 volts. Some radios may be as low as 9.1 volts and others may be as high as 10.1 volts. However, the regulation for a given radio is ±100 millivolts from the regulated value over the entire range of input voltage, load, and temperature.

The output of the regulator develops the "9.6 volts continuous" which is applied to reed switch K902 and to some receiver and PL encoder circuits. In the receive mode, "switched 9.6 volts" is applied to certain receiver circuits. In the transmit mode, the "switched 9.6 volts" is removed and the "keyed 9.6 volts" is applied to exciter board.

c. Netting

The NET contacts permit the switched 9.6 volts and the keyed 9.6 volts to be activated simultaneously by inserting the radio key or similar shorting tool into the eyelet on the circuit board labelled NET. This activates only the exciter and receiver circuits simultaneously for netting (setting the transmitter and receiver on the same exact frequency).

All radios in a network are set to exactly the same frequency by using the NET contacts in the following manner. A "master" station is accurately set on-frequency with calibrated test equipment. The "master" station transmits an unmodulated carrier signal. All listening receivers are adjusted for an exact on-frequency indication (exact zero output from the discriminator). The "master" station stops transmitting. In each radio, the NET contacts are shorted and a small amount of carrier signal from the exciter is picked up by the receiver. The transmitter frequency is now adjusted for exact zero indication from the discriminator. The receiver has already been calibrated so now the transmitter is adjusted to match the receiver. Thus maximum range and signal clarity are achieved by having all stations of the network "netted" to the same frequency standard.

d. Push-To-Talk Switching and Sequencing Circuit
(Refer to Figure 3)

The push-to-talk switching and sequencing circuits control the application of dc power to the transmitter and control the sequencing so the transmitter is terminated in the antenna before rf output is applied. Sequencing during transmitter turn-off assures that rf power output is ended before the antenna is switched back to the receiver.

(1) Transmitter Turn-On

The following sequence of actions occurs to turn on the transmitter.

-- Transmitter keying is initiated by closing the push-to-talk switch on the microphone.

-- Closing the push-to-talk switch grounds one side of the 1st P-T-T reed switch (K901) coil. The other side of the coil is connected to filtered A+ causing the reed switch to energize, closing the contacts.

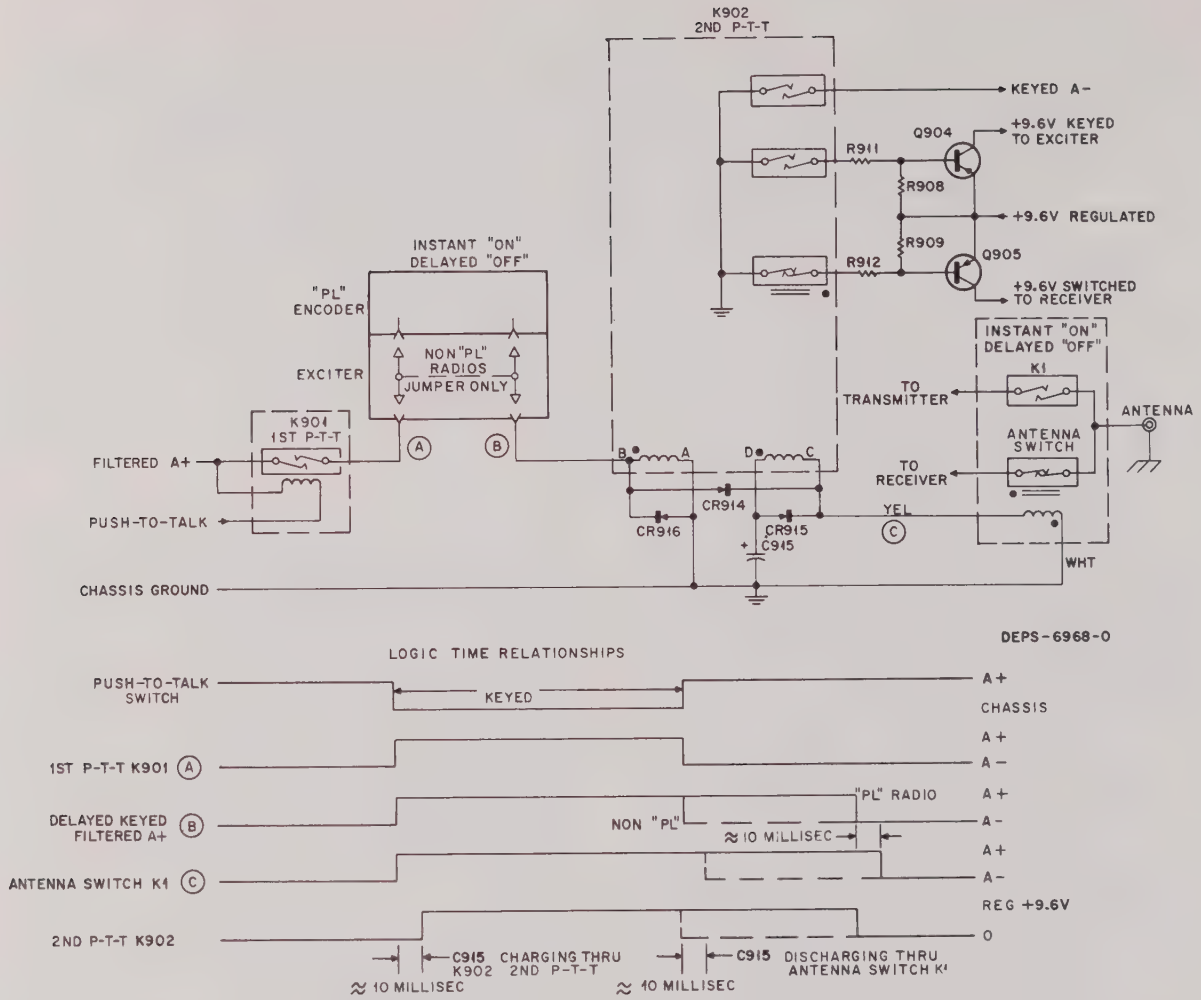

Figure 3.
Push-To-Talk Switching and Sequencing Circuit

-- Keyed A+ from K901 is routed through the exciter (and the PL encoder in PL radios) to the 2nd P-T-T reed switch K902.

-- Initially, current flows through both coils of K902, producing opposite and cancelling magnetic fields. The reed switch does not energize at this time.

-- "Keyed A+" is routed through diode CR914 to the antenna switch. The antenna switch energizes and transfers the antenna from the receiver to the transmitter.

-- After approximately 10 milliseconds delay, C915 becomes charged and current through coil #2 of K902 decreases to the point where full magnetic cancellation no longer occurs. K902 energizes and applies "keyed A-" to the exciter and to the base resistor (R911) of Q904. This turns on Q904 and applies "keyed 9.6 volts" to the exciter, allowing rf output to be developed. At the same time, A- is removed from base resistor R912. This "turns-off" Q905, removing "switched 9.6 volts" from the receiver.

(2) Transmitter Turn-Off

When the push-to-talk switch on the microphone is released, the following sequence of actions occurs:

-- K901 de-energizes immediately.

-- In "Private-Line" radios, "keyed A+" continues for approximately 150 milliseconds after unkeying. This delay is produced by the PL encoder. In non-"Private-Line" radios, "keyed A+" is removed as soon as K901 de-energizes.

-- K902 de-energizes immediately upon loss of "keyed A+", removing power from the transmitter.

-- C915 discharges through the antenna switch coil. Sufficient current is available to produce approximately 10 milliseconds delay before the antenna reed switch de-energizes. This allows transmitter rf power output to go to zero before the antenna connection is transferred from the transmitter to the receiver.

e. Frequency Selection Circuits
(Refer to Figure 4)

Diodes CR901 through CR908 form a matrix which is used to control the selection of the proper transmit and receive channel elements. The frequency selector switch on the control head applies ground to one pair of diodes for each switch position. The diodes route the ground to the F1 transmitter and receiver channel elements when the switch is in the F1 position, to the F2 channel elements when the switch is in the F2 position, etc.

When a two-frequency control head is used with a radio equipped for two-frequency transmitter and single-frequency receiver operation (T2-R1 operation), only one receiver channel element is used and that is installed in the F1 position. A jumper from CR907 to CR908 (anode end) routes ground to the receiver F1 channel element whenever the frequency selector switch is in the F1 or F2 position.

The same principle holds true for four-frequency radios that are operating with less than four transmitting or receiving frequencies. For example, a radio set may have two transmitting frequencies and four receiving frequencies (T2-R4 operation). Jumpers are added to select one of the two available transmitting frequencies for each of the F1-F2-F3-F4 frequency selector switches. The diodes prevent dc interaction between channel elements when jumpers are used. The basic jumper connections for each type of operation are listed in the accompanying table and Figure 5. It shows that the basic jumper connections for T2-R4 operation will select transmitter frequency F2 when the F3 or F4 selector switches are operated. If, instead, it is desirable to select transmitter frequency F1 when the F3 or F4 selector switches are operated, or to have receive only operation when F3 or F4 is selected, the jumper arrangement must be modified. Still other variations are possible by changing the positions of the channel elements that are used. If frequencies are added, jumpers must be removed to prevent more than one channel element from being activated simultaneously.

NOTE

FCC approval is required before adding or changing frequencies.

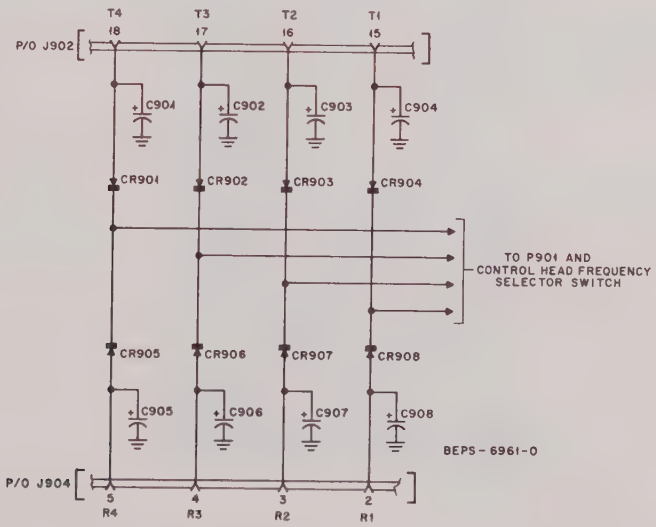

Figure 4.
Frequency Selector Circuit

Proper jumper connections and locations of channel elements for all types of operation can be calculated from the following procedure and typical examples. To receive the same frequency for more than one of the F1-F2-F3-F4 switch selections, jumper the corresponding points together on the control board.

EXAMPLE 1

Condition Desired:

Receive -
159.420 MHz on F1 and F4 positions
159.510 MHz on F2 position
159.600 MHz on F3 position

Procedure:

Jumper point R1 to point R4. Insert the 159.420 MHz channel element into the receiver F1 position. No channel element is used in the receiver F4 position.

EXAMPLE 2

Condition Desired:

Receive -
159.420 MHz on F1 and F3
159.600 MHz on F2 and F4

Procedure:

Jumper point R1 to R3 and insert the 159.420 MHz channel element into the receiver F1 position and none into the F3 position. Jumper point R2 to R4 and insert the 159.600 MHz channel element into the receiver F2 position and none into the F4 position.

To transmit the same frequency for more than one position of the F1-F2-F3-F4 switch selections, jumper the corresponding points together on the control board.

EXAMPLE 3

Condition Desired:

Transmit -
159.420 MHz on F1
159.510 MHz on F2 and F4
159.600 MHz on F3

Procedure:

Jumper point T2 to T4. Insert the 159.510 MHz channel element into the transmitter F2 position. No channel element is used in the transmitter F4 position. The transmitter F1 and F3 channel element are installed in the normal manner.

f. Discriminator Buffer
(Refer to Figure 6)

The discriminator output is buffered through an emitter follower stage consisting of Q908, R924, R925, and R926. The input to the emitter follower is from pin 2 of IC201, on the audio and squelch board, via J903-3. This is coupled through C919. The buffered output from the emitter follower is coupled through C920 to P901-9 and to the connector board.

g. Volume and Squelch Control

The receiver audio output volume and threshold squelch controls are located on the control board. The audio output level can be increased by turning the VOL control (R923) clockwise. To increase the amount of received signal necessary to break the squelch threshold, turn the SQ control (R918) clockwise.

h. "AND" Type Squelch and Transmitter PL Tone Disable
(Refer to Figure 7)

In PL tone-coded squelch radios, with the PL switch on the control head in the OFF position, the receiver is in a "carrier squelch mode".

BASIC JUMPER CONNECTIONS FOR MULTI-FREQUENCY RADIO SETS

NO. OF FREQS.		JUMPERS				JUMPERS				RCVR CHAN ELEMENT LOCATION				XMTR CHAN ELEMENT LOCATION			
XMIT	RCV	R1	R2	R3	R4	T1	T2	T3	T4	1	2	3	4	1	2	3	4
1	4	○	○	○	○	●	●	●	●	X	X	X	X	X			
2	4	○	○	○	○	○	●	●	●	X	X	X	X	X	X		
3	4	○	○	○	○	○	○	●	●	X	X	X	X	X	X	X	
4	4	○	○	○	○	○	○	○	○	X	X	X	X	X	X	X	X
1	3	○	○	●	●	●	●	●	●	X	X	X		X			
2	3	○	○	●	●	○	●	●	●	X	X	X		X	X		
3	3	○	○	●	●	○	○	●	●	X	X	X		X	X	X	
4	3	○	○	●	●	○	○	○	○	X	X	X		X	X	X	X
1	2	○	●	●	●	●	●	●	●	X	X			X			
2	2	○	●	●	●	○	●	●	●	X	X			X	X		
3	2	○	●	●	●	○	○	●	●	X	X			X	X	X	
4	2	○	●	●	●	○	○	○	○	X	X			X	X	X	X
1	1	●	●	●	●	●	●	●	●	X				X			
2	1	●	●	●	●	○	●	●	●	X				X	X		
3	1	●	●	●	●	○	○	●	●	X				X	X	X	
4	1	●	●	●	●	○	○	○	○	X				X	X	X	X

CAUTION

WHEN ADDING CHANNEL ELEMENTS, JUMPERS MUST BE REMOVED. REMOVE JUMPERS SHOWN BY DASHED LINES IN THE TABLE.

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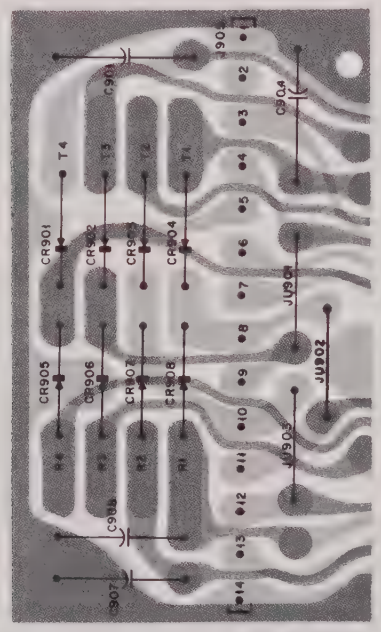

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Figure 5.
Diode and Jumper Locations

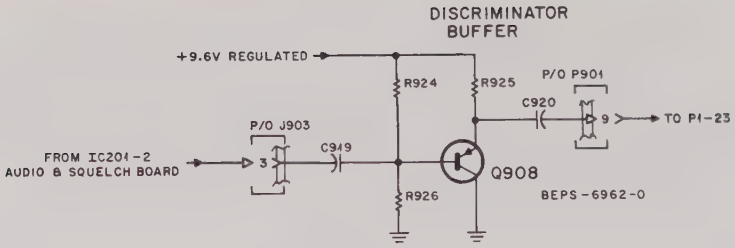


Figure 6.
Discriminator Buffer Circuit

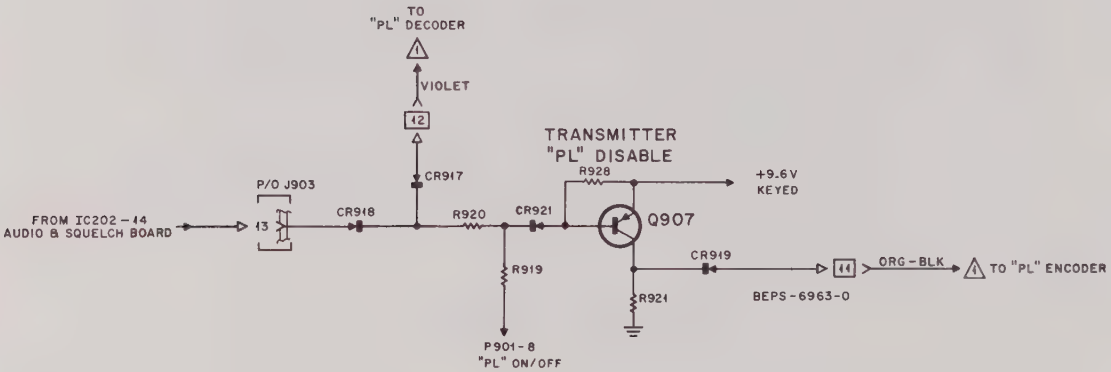


Figure 7.
"AND" Type Squelch and Transmitter
PL Disable Circuit

This means that a carrier of sufficient signal strength will break squelch regardless of any form of modulation present on the carrier. With the PL switch in the ON position, R920 (on the control board) is grounded and draws current through CR918 from pin 14 of IC202 on the audio and squelch board. This condition places the receiver in a "carrier squelch disable mode". In this state, no carrier of any strength can break squelch due to noise quieting. A dc output from the PL decoder board, caused by detection of PL tone modulation, is routed to pin 8 of IC202 to break squelch. Under these conditions PL sensitivity is fixed and will open to PL signals of 0.125 uV or less.

(1) "AND" Type Squelch

"AND" type squelch operation in PL radios can be obtained by cutting JU801 on the PL decoder board. The PL decoder output is now routed through CR917 to the cathode of CR918, stopping current flow through CR918 when a PL tone is detected. The presence of a PL tone has returned the receiver from a "carrier squelch disable" to a "carrier only" mode.

Therefore, if the carrier is of sufficient strength and the proper PL tone is detected, the radio will break squelch. In "AND" type squelch operation the setting of the squelch (SQ) control will also set the sensitivity of the PL tone threshold.

(2) Transmitter PL Tone Disable

The transmitter PL tone disabler turns on and off the PL tone modulation. With the PL switch, on the control head, in the ON position, the base resistor (R919) of transistor Q907 is grounded. This switches Q907 on, placing 9.6 V on the cathode of CR919 and cutting it off. With no conduction through CR919, the PL encoder tone is passed to the exciter.

With the PL switch in the OFF position, resistor R919 is opened, cutting off Q907. This allows CR919 to conduct; biasing Q704 on the PL encoder board off and thus preventing the PL tone from leaving the encoder board. In the PL off condition, no PL modulation is present on the transmitter carrier.

i. Microphone Sensitivity
(Refer to Figure 8)

To compensate for the high ambient noise associated with railroad engines, the microphone input line to the exciter includes an audio pad. With the pad included (R901 & R902), 0.36 volts ±3 dB of a 1000-Hz tone will provide ±3.5 kHz deviation. In this condition (for radios to be used for railroad operation) JU905 is IN and JU904 is OUT.

The input sensitivity may be increased to 0.165 volts ±3 dB by removing JU905 and adding JU904. This higher sensitivity may be advantageous if the radio is to be used in lower ambient noise environments.

j. Auxiliary Squelch
(Refer to Figure 9)

An auxiliary squelch indication is provided at P901-5 (P1-17). This indication is +9.5 volts for an unsquelched condition and 0 volts for a squelched condition. The circuit consists of a transistor-switch inverter-buffer, Q906, controlled by the voltage present at pin 10 of IC202 on the audio and squelch board. When the receiver is unsquelched, pin 10 of IC202 is 0 volts. This places 0 volts on the base resistor R916, of Q906 and cuts Q906 off. The collector of Q906 will be at +9.6 volts. When the receiver is squelched, pin 10 of IC202 is +8.7 volts. This turns on Q906, causing it to saturate, the collector voltage will now be 0 volts.

k. Page/Extend

The PAGE option is available with special control heads. It allows the operator to use the receiver audio power amplifier in a public address function. With the PAGE/EXTEND switch, or the special control head, in the PAGE position, the P-T-T line (P901-14) in the control head is opened and the microphone is biased through R910, CR913 and CR920 on the control board. The microphone audio modulates the "page" line (P901-11). This signal is coupled through C914 to the audio board via the T-O-T tone line.

3. MAINTENANCE

Many overall radio set checks and specific control board circuit checks can be made by connecting a Motorola portable test set and TEK-37

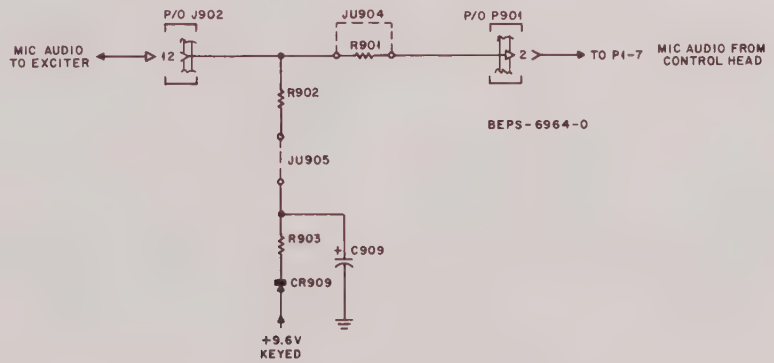


Figure 8.
Microphone Sensitivity Circuit

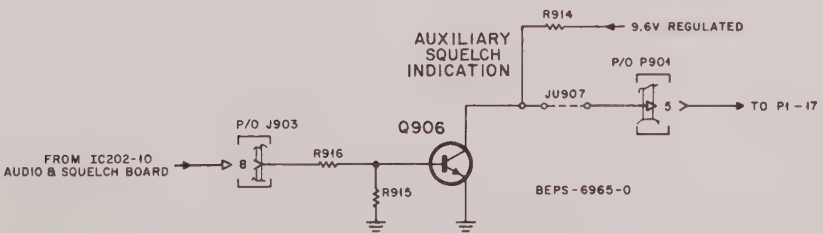


Figure 9.
Auxiliary Squench Indication Circuit

Adapter Cable to the control socket on the control board. The following list summarizes the checks that can be performed and the results for normal operation.

a. Speaker Audio

To monitor speaker audio, merely place the SPKR-OFF-LOAD switch in the SPKR position. The speaker in the test set may now be used to monitor received calls during testing.

To measure the level of the speaker audio, such as for 20 dB quieting checks, perform the following steps:

(1) Set the mode selector switch to the RCVR position.

(2) Set the position selector switch to position 11.

(3) Set the speaker switch to the OFF position and terminate the speaker audio in its normal 8-ohm load.

(4) Set the multiplier to the .2 V or 2 V position as required for the test being performed.

(5) Set the oscillator and meter reversing switch to the OFF position.

b. Microphone Audio

To transmit test messages using the portable test set, connect a microphone to the test set, terminate the transmitter in a dummy load or antenna and set the mode selector switch to the XMTR position. Send messages using the microphone connected to the test set.

To measure the microphone audio level, set the position selector switch to position 11 and the multiplier switch to the .2 V position. Read the meter for audio level indication from the microphone connected to the test set or the microphone connected to the control head of the radio.

c. Supply Voltage

To measure supply voltage:

(1) Connect the red control plug to the socket on the control board.

(2) Set the selector switch to position 10. Do not key the transmitter.

(3) Set the meter reversing and oscillator switch to the OFF position.

(4) Read the radio set's input voltage on the 15-volt scale of the meter. Normal reading should be approximately 13.8 volts.

d. 9.6-Volt Regulator

To measure keyed 9.6 volts:

(1) Connect a dc voltmeter to pin 4 of the control socket on the control board (chassis reference).

(2) The meter should read 9.1 to 10.1 volts.

(3) If the 9.6 volt output is abnormal, measure the dc voltages in the regulator circuit. Refer to the schematic diagram for typical values.

REFERENCE SYMBOL	MOTOROLA PART NO	DESCRIPTION

ELECTRICAL PARTS LIST

IMPORTANT

USE ONLY THE FOLLOWING MOTOROLA PART NUMBERS WHEN ORDERING REPLACEMENT PARTS

TLN4574A Control Board — PL-1304-A

		CAPACITOR, fixed: uF; ±20%, 20 V, unl stated
C901 thru 908	23-84762H04	2.7; 25 V
C909	23-83214C02	15; 25 V
C910	23-82783B31	47
C911	23-83210A19	500 - 100; 10%
C912	23-82601A25	100 - 150; 10%
C913	23-82601A11	5 - 33; 10%, 25 V
C914	8-83813H11	0.22 ±10%; 75 V
C915	23-82783B31	47
C916	23-82783B31	47
C917	23-82783B31	47
C918	23-83214C05	6.8 ±10%; 15 V
C919	8-83813H01	0.22 ±10%; 75 V
C920	8-83813H01	0.22 ±10%; 75 V
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR901 thru 908	48-82466H12	silicon
CR909	48-82392B03	silicon
CR910	48-82392B03	silicon
CR911	48-82256C16	silicon; Zener type; 8.2 V ±5%
CR912 thru 918	48-82392B03	silicon
CR919	48-82178A06	germanium
CR920 thru 922	48-82392B03	silicon
		CONNECTOR, receptacle:
J901		NOT USED
J902		(for reference only)
J903		(for reference only)
J904		(for reference only)
J905	28-10586A01	male; 14-contact
J906		(for reference only)
J907	9-84207B01	female; 7-contact
		SWITCH, magnetic reed:
K901	80-84157B01	1 form "A"; coil res 820 ohms ±10%
K902	80-84157B02	2 form "A" , 1 form "B"; two coils; each coil 285 ohms ±10%
		REACTOR:
L901	25-84134B01	AF choke; 10 mH; res 0.5 ohm max.
		COIL, RF: Assembly; includes: 24-80907A18 COIL, RF; choke 26-82604A03 SHIELD; coil 37-134165 SLEEVE, heat-shrink
L902	1-80727B45	
		CONNECTOR, plug:
P901		(for reference only)
		TRANSISTOR: (SEE NOTE)
Q901	48-869647	P-N-P, type M9647
Q902	48-869570	N-P-N; type M9570
Q903	48-869570	N-P-N; type M9570
Q904	48-869641	P-N-P; type M9641
Q905	48-869641	P-N-P, type M9641
Q906	48-869570	N-P-N; type M9570
Q907	48-869571	P-N-P, type M9571
Q908	48-869571	P-N-P, type M9571
		RESISTOR, fixed: ±10%, 1/4 W; unl stated
R901	6-131275	220 ±5%
R902	6-124A44	±20 ±5%
R903	6-129779	560 ±5%
R904	6-129433	5.6k
R905	6-129235	1.2k
R906	6-124A05	15 ±5%
R907	6-124A19	56 ±5%
R908	6-129863	390
R909	6-129863	390
R910	6-129620	560
R911	6-129235	1.2k

R912	6-129235	1.2k
R913	6-131652	39
R914	6-127804	4.7k
R915	6-129225	10k
R916	6-128685	22k
R917	6-129231	3.3k
R918	18-83083G24	var; 25k ±30%
R919	6-129432	820
R920	6-6432	270; 1/2 W
R921	6-127802	1k
R922	6-129231	3.3k
R923	18-83083G24	var; 25k ±30%
R924	6-127807	33k
R925	6-129231	3.3k
R926	6-127807	33k
R927	6-129620	560
R928	6-128752	270

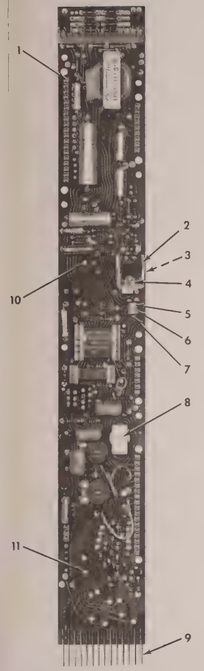
NOTE:

Replacement diodes and transistors must be ordered by Motorola part number only for optimum performance.

MECHANICAL PARTS LIST

TLN4574A Control Board — PL-1313-O

CODE	MOTOROLA PART NO.	DESCRIPTION
1	29-10134A29	TERMINAL, contact: female; 56 req'd.
2	7-84234B01	BRACKET, transistor mounting: (heat sink)
3	3-134169	SCREW, tapping: 4-40 x 1/4" "Phillips" hex head (ext. lockw.)
4	3-134185	SCREW, tapping: 6-32 x 1/4" "Phillips" hex head (ext. lockw.)
5	2-9627	NUT, machine: 4-40 x 3/16" hex
6	4-10058A30	WASHER, insulating: nylon
7	3-10129A07	SCREW, machine: nylon; 4-40 x 3/8" slotted Fillister head
8	7-84233B01	BRACKET ("netting switch")
9	28-84018D01	TERMINAL, contact: male; 14 req'd
10	29-855943	TERMINAL, contact: male; 5 req'd
11	39-10184A30	TERMINAL, contact: male; 16 req'd.



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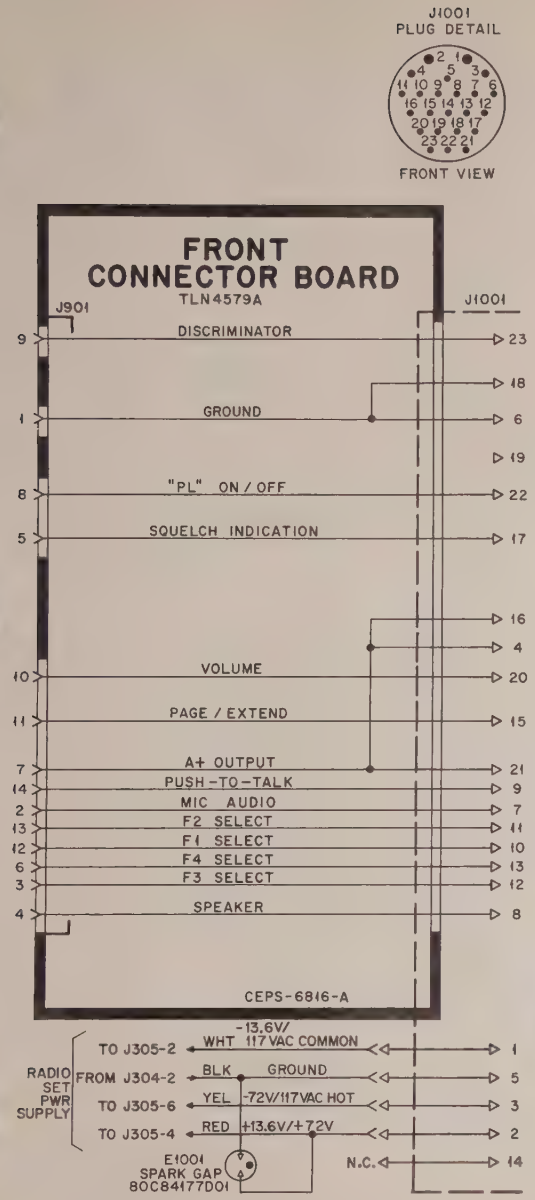
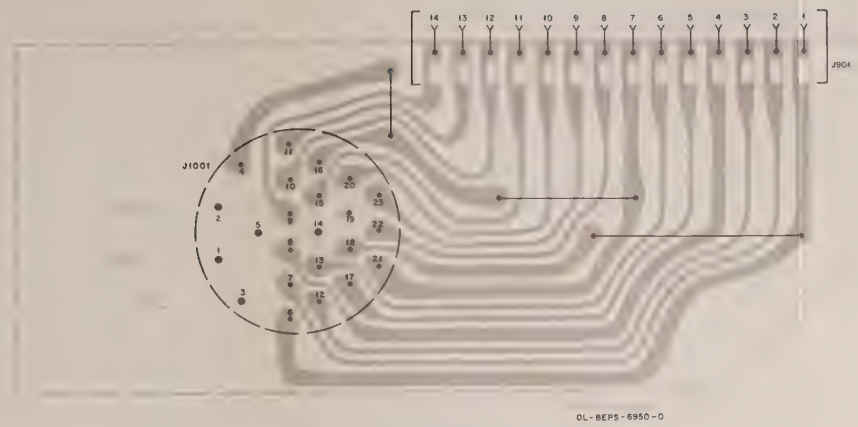
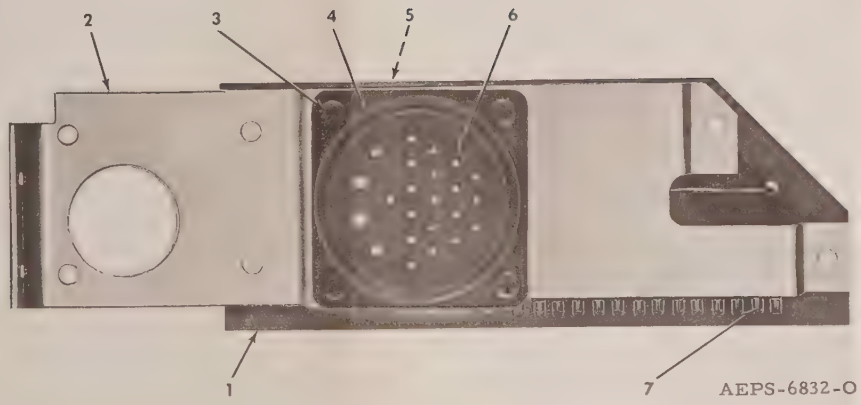
CONTROL BOARD







MECHANICAL PARTS LIST

TLN4579A Front Connector Board PL-1312-B

CODE	MOTOROLA PART NO.	DESCRIPTION
1	84-84943C01	CIRCUIT BOARD (less contacts)
[illegible]	[illegible]	BRACKET [illegible]
[illegible]	[illegible]	SCREW, tapping [illegible] Phillips [illegible] head text. [illegible] PLF 4 req'd
4	14-84[illegible]D 1	BODY connector front section
[illegible]	14-84[illegible]D [illegible]	BODY connector rear section
[illegible]		TERMINAL contact male, see following list: 28-84[illegible]D [illegible] terminals 1, 2 28-84[illegible]D [illegible] terminal [illegible] 28-84[illegible]D [illegible] terminals 5, 14) 28-84[illegible]D 4 terminal 4) 28-84[illegible]D [illegible] (terminals 6 thru [illegible])
7	29-10134A29	TERMINAL, contact: female; 14 req'd

NOTES

I. Items 4 thru 6 can be obtained as a complete connector. Order part No. 28-84957C01.

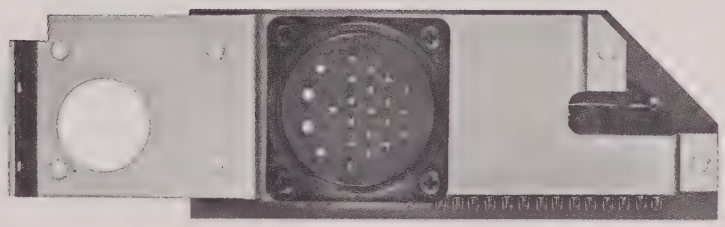
II Items 1 and 7 can be obtained as an assembly. Order assembly No. 1-80718B86.

FRONT CONNECTOR BOARD

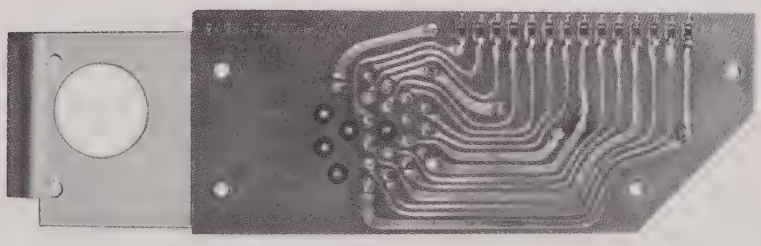
Front Connector Board
Schematic Diagram & Circuit Board Detail
Motorola No. 63P81013E26-B
7/29/74-NPC

FRONT CONNECTOR BOARD

MODEL TLN4579A



FRONT VIEW



REAR VIEW

AEPS-6948-O

MOTOROLA INC. Communications Division
ENGINEERING PUBLICATIONS 1301 E. ALGONQUIN ROAD SCHAUMBURG, ILLINOIS 60172

1. CIRCUIT BOARDS USED

APPLICATION	CIRCUIT BOARD: TLN4577A Transient Filter Board	TLN4578A Fuse Board	TPN6064A 13.6 V DC Power Converter Board	TPN6065A 72 V DC Power Converter Board	TLN4576A High End Regulator Board
13.6/72 V DC	X		X	X	X
13.6 V DC		X	X		X
72 V DC	X			X	X

2. TECHNICAL CHARACTERISTICS

INPUT VOLTAGE	10.9 to 18.0 volts (13.6 volts nominal) 58 to 85 volts (72 volts nominal)
OUTPUT VOLTAGE AT NOMINAL INPUT	13.6 volts @ 10 amps (transmit) 14.5 to 16.0 volts @ 2 amps (receive)
HIGH END REGULATION POINT	16.25 volts ±0.25 volt
MAXIMUM OUTPUT CURRENT	12 amps (converter stalls if current exceeds this value)
AMBIENT TEMPERATURE RANGE	-30°C to +65°C

MOTOROLA INC. Communications Division
ENGINEERING PUBLICATIONS 1301 E. ALGONQUIN ROAD SCHAUMBURG, ILLINOIS 60172

3. DESCRIPTION

Three power supply deck circuit board configurations permit the radio set to operate from a 13.6-volt power source, from a 72-volt power source, or from either a 13.6- or 72-volt power source. Three circuit boards are required in single-voltage systems while four circuit boards are required in two-voltage systems. The 13.6/72 volt power supply deck uses a transient filter board, 13.6 and 72 volt dc power converter boards, and a high end regulator board. The 72-volt power supply deck uses the same boards -- less the 13.6-volt dc power converter board. The 13.6-volt power supply deck uses a fuse board (in place of the transient filter board), a 13.6 volt dc power converter board, and a high end regulator board.

The floating primary circuit of the power supply allows operation in either positive or negative ground systems, or with floating input voltages as long as proper polarity is observed at the input terminals on the AAR mounting rack.

NOTE

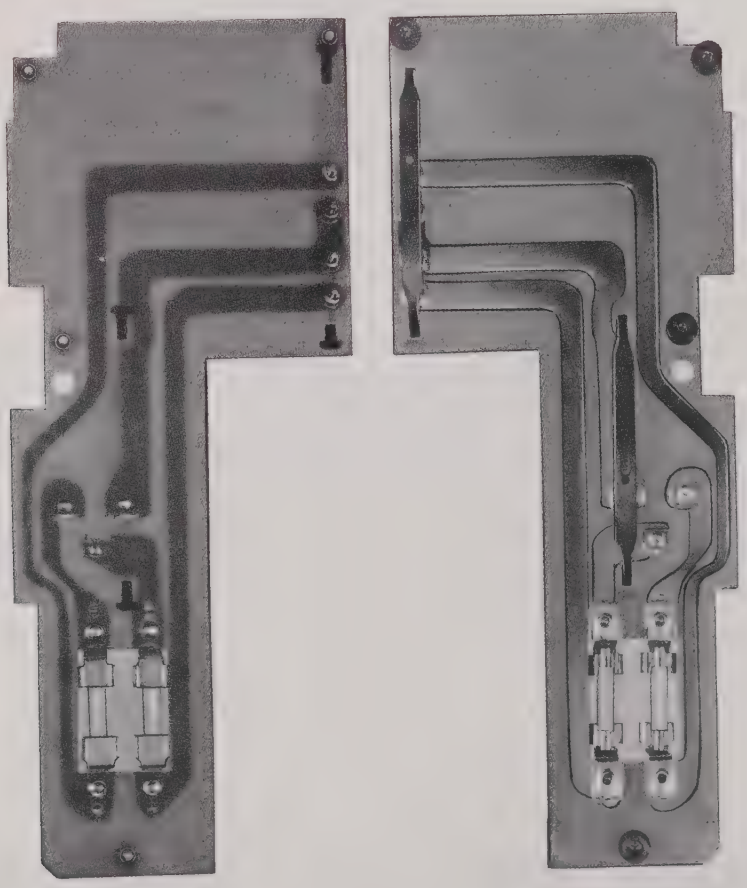
Refer to the INSTALLATION section of this manual for proper connection information.

The interconnected, plug-in circuit boards which are mounted on the bottom side of the radio can be removed individually or as a unit. They are removed individually by loosening the captive screws associated with the specific board or as a unit by loosening the red captive screws around the perimeter of the deck.

CAUTION

To prevent power supply damage, silicone compound must be used between the surfaces indicated on mechanical parts list photographs in this section and in the MAINTENANCE section of this manual.

Input voltage to the power supply deck is applied at the transient filter board or fuse board. Both circuit boards protect the radio set from improper input power connections. The transient



BEPS-6982-O

Figure 1.
Fuse Board

filter board also, however, eliminates the harmful effects of very high voltage spikes which may be present on locomotive power lines. From the transient filter board, or fuse board, the input voltage is routed to the applicable power converter board -- either the 13.6 V dc power converter board or the 72 V dc power converter board. The power converter boards provide a specific range of output voltages even during varying input voltage conditions. They also provide short circuit and overload protection by causing the power supply to cease action during these conditions. Power converter board output is routed to the high end regulator board which limits the power supply deck output voltage to a specific maximum output level.

The transient filter board, fuse board, and power converter boards are designed with large connectors and heavy plating runs with a minimum spacing of 1/4 inch between the runs. This ensures against "arcing" caused by high voltage transient spikes.

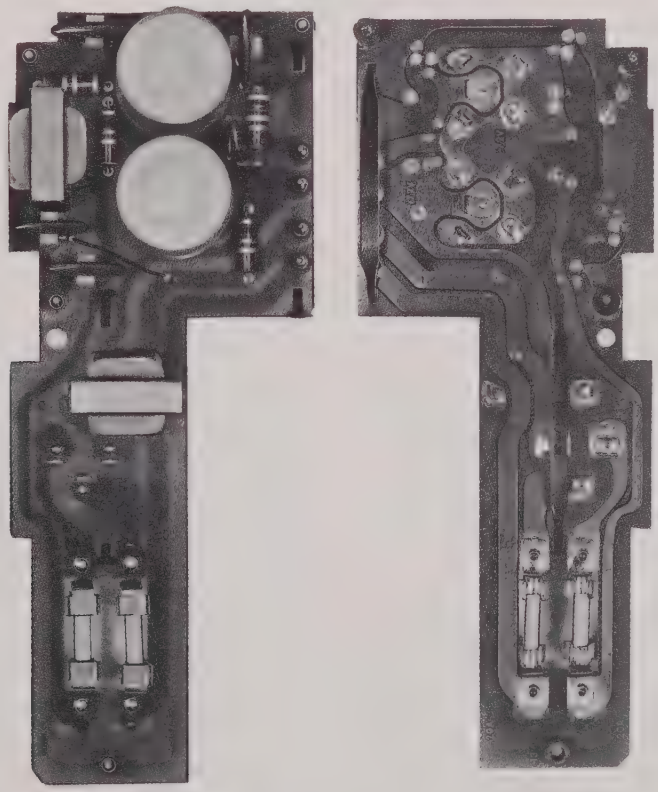
Metering receptacles are provided on the power converter boards and high end regulator board to facilitate rapid localization and identification of a malfunction to a specific circuit board and area.

4. FUSE BOARD

This circuit board provides interconnection for primary power from J305 to the regulator board. The fuses provide protection against an input voltage of the wrong polarity. If the polarity of the input voltage to the radio set is incorrect, diode CR341 on the 13.6 V dc power converter board conducts shorting the input lines together, causing fuse F381 to open.

5. TRANSIENT FILTER BOARD

This circuit board provides two types of protection against transient voltage spikes -- line-to-line and line-to-ground. Refer to Figure 3.



BEPS-6981-O

Figure 2.
Transient Filter Board

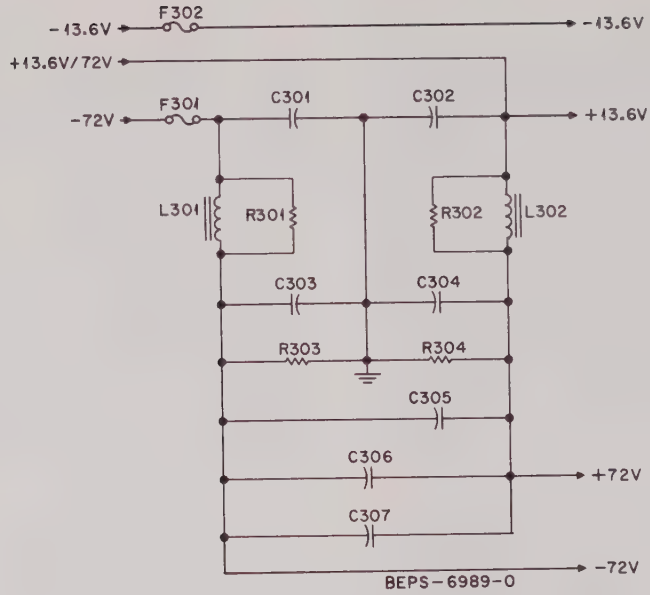


Figure 3.
Simplified Transient Filter Board

a. Line-To-Line Transient Protection

These high voltage transient spikes appear across the 72-volt lines and are absorbed by capacitors C305, C306, and C307. Bleeder resistors R303 and R304 allows the capacitors to discharge to eliminate a possible shock hazard as well as to allow the transient filter to work effectively on repetitive voltage spikes.

b. Line-To-Ground Transient Protection

These voltage transients are present on the +72 and -72 volt lines with respect to ground and can be of extremely high voltage. To protect the transient filter and power supply from such high voltages, a spark gap device is used (located behind the front panel) which conducts when the voltage across it exceeds 1750 volts. This produces a relatively low energy level spike which is passed on to the transient filter board.

The transient filter board absorbs the high-frequency energy from the leading edge of the remaining spike with low pass filters. This slows the voltage rise rate of the spike which prevents damage to the power converter board inverter transistors. Only the voltage rise filtering is necessary, since the power converters can withstand steady-state dc voltages of up to 3000 volts. The low pass filter used with the +72 volt line consists of capacitors C302 and C304, coil L302, and resistor R302. The low pass filter used with the -72 volt line consists of capacitors C301 and C303, coil L301, and resistor R301.

6. 13.6 V DC POWER CONVERTER BOARD

a. General

Refer to Figure 5. This circuit board is a dc to dc converter which supplies a nominal 17.5 volts dc (transmitter unkeyed) or a nominal 14.6 volts dc (transmitter keyed) to the regulator board from a nominal 13.6 volt dc input. This is accomplished by an inverter circuit (free running multivibrator) which develops an alternating voltage, then rectifying the alternating voltage to produce a positive dc output. An inverter drive control circuit is used to provide more current output when the transmitter is keyed. Inherent short circuit protection prevents power supply damage if the current demand exceeds 12 amperes, and a polarity protection circuit prevents power supply damage if connections from the primary power source are reversed.

b. Inverter Circuit

The inverter circuit is a free running multivibrator which operates at approximately 5 kHz. The circuit consists of transistors Q342 and Q343, saturable core transformer T341 and associated components. The negative polarity of the input voltage (-13.6 V) is applied to the emitters of Q342

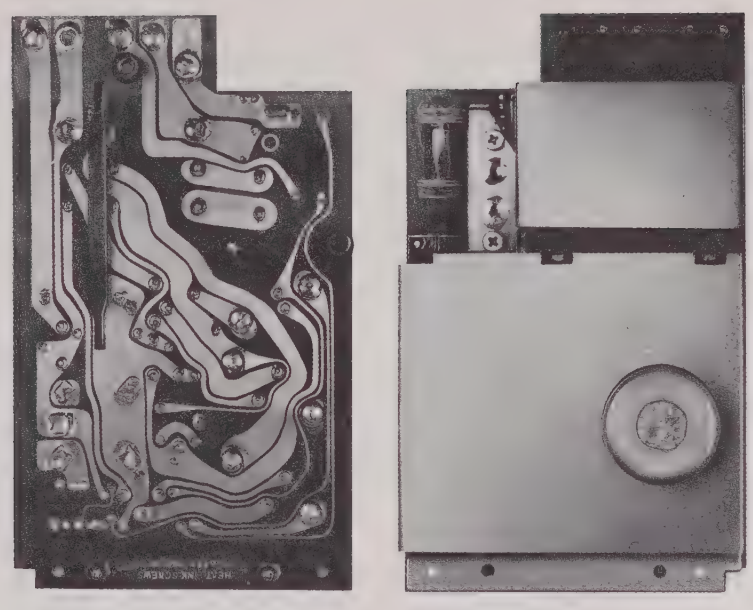


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Figure 4.
13.6 V DC Power Converter Board

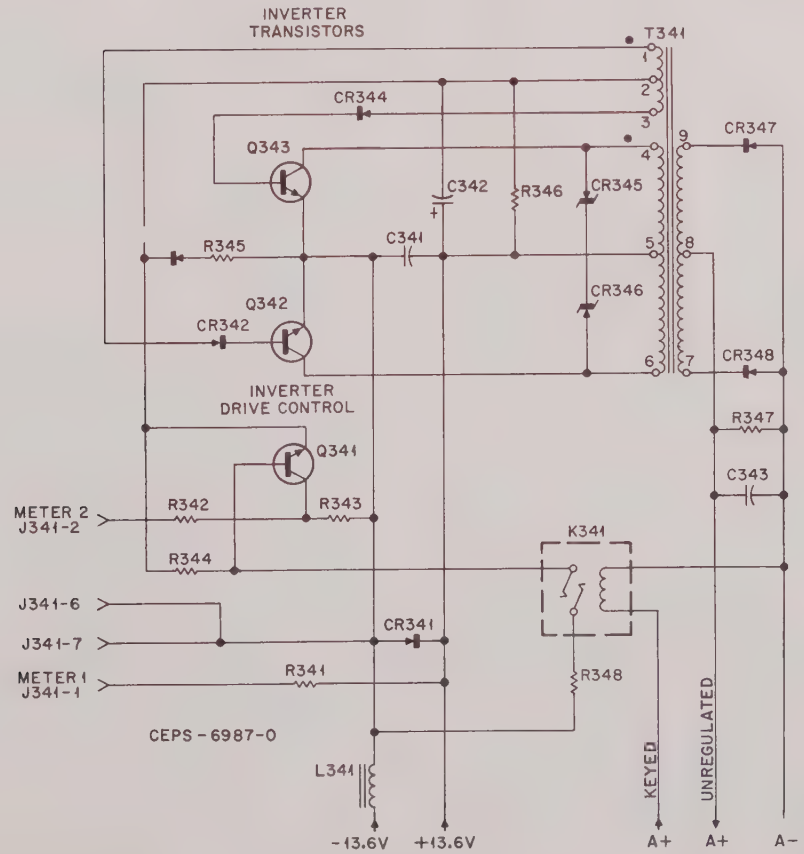


Figure 5.
Simplified 13.6 V DC Power Converter Board

5 kHz. The circuit consists of transistors Q362 and Q363, saturable core transformer T361 and associated components. The negative polarity of the input voltage is applied to the emitters of Q362 and Q363; the positive polarity is applied to the collectors through transformer T361. The starting voltage is applied to both transistors, but slight imbalance will cause one transistor to conduct before the other. Assume Q362 conducts first. The resulting increase in Q362 collector current through the primary of the transformer induces a voltage in the feedback winding of the correct polarity to cause Q362 to be driven to saturation and Q363 to be driven to cutoff. As the transformer saturates, causing no change in flux density, the drive to the base of Q362 is reduced and its collector current begins to decrease. This causes a change in flux density in the opposite direction that drives Q362 into cutoff and Q363 into saturation. The action repeats with Q362 and Q363 alternately conducting, thus developing an alternating voltage across the secondary (output) winding of transformer T361.

Coil L361 prevents high frequency components created by transistor switching action from conducting into the input supply lines. Capacitor C363 and resistor R367 is a voltage despiking network which limits the collector-to-emitter voltage of both inverter transistors to a safe value.

c. Rectifier-Filter Circuit

The peak-to-peak voltage developed across the primary of transformer T361 is approximately four-times the input voltage to the circuit board. The center tapped step-down secondary and diodes CR365 and CR366 provide full wave rectification while resistor R368 and capacitor C364 filter high frequency switching components. The dc output voltage varies directly with the input voltage; that is, the output voltage of the converter increases when the input voltage increases and vice versa.

d. Inverter Drive Control Circuit

When the transmitter is keyed additional current capability is provided by increased feedback voltage to the switching transistors. Keyed A+ energizes relay K361, which then applies forward bias to and saturates inverter drive control transistor Q361. Resistor R363 is placed in parallel with resistor R365, providing greater base drive to inverter transistors Q362 and Q363.

e. Short Circuit Protection Circuit

Operating characteristics of the converters provide self-protection in case a short circuit develops in the power supply load. A short circuit causes a heavy current demand and the inverter circuit stops switching due to loss of feedback. When switching action stops, capacitor C362 (which provided a low impedance path for initial start up) will charge up and limit the base current of the switching transistors to a safe level. The inverter circuit may not be self-starting after a short circuit has been removed. To restart the inverter circuit, it may be necessary to turn off and then restore power.

f. Polarity Protection Circuit

Diode CR361 provides polarity protection for the power supply if connections to the primary power source are reversed. If reverse polarity is applied, CR361 becomes forward biased and causes line fuse F301 on the transient filter board to open.

g. Circuit Metering

Convenient test point monitoring capability with a Motorola portable test set is provided by metering receptacle J361.

METER POSITION	FUNCTION MONITORED
1	Input primary voltage
2	Drive control transistor collector

8. HIGH END REGULATOR BOARD

a. General

The voltage output of the power supply deck is nearly the same as its input voltage as long as the input voltage is below 16.5 volts. When the input voltage is higher, the high end regulator board restricts power supply deck output to 16.25 ±0.25 volt. Refer to Figure 9.

b. Input Voltage Less Than 16.25 Volts (Approx.)

When the input voltage is applied to the high end regulator board, all of the control amplifier transistors conduct, driving regulator transistor

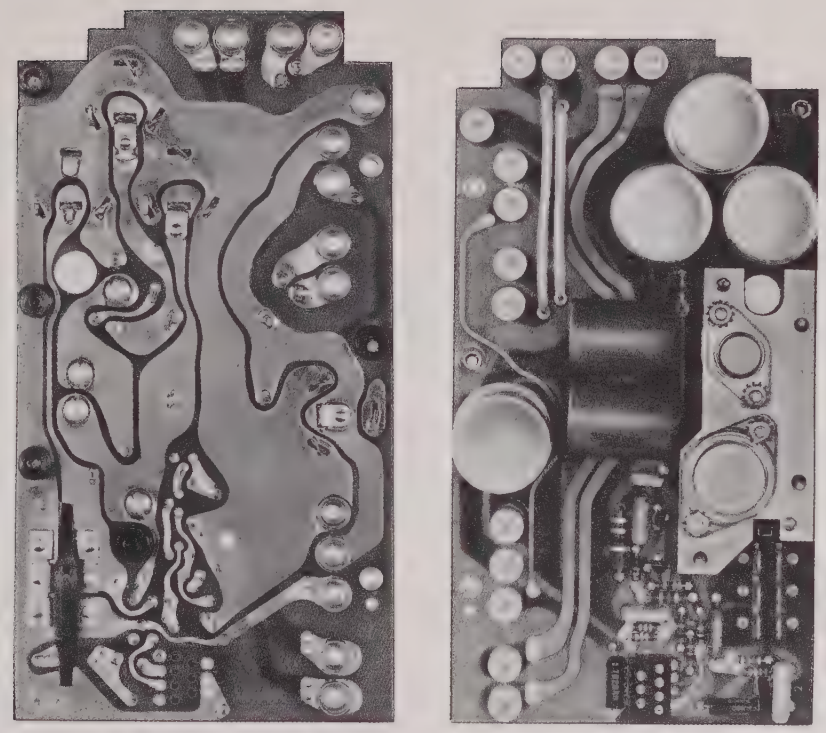


Figure 8.
High End Regulator Board

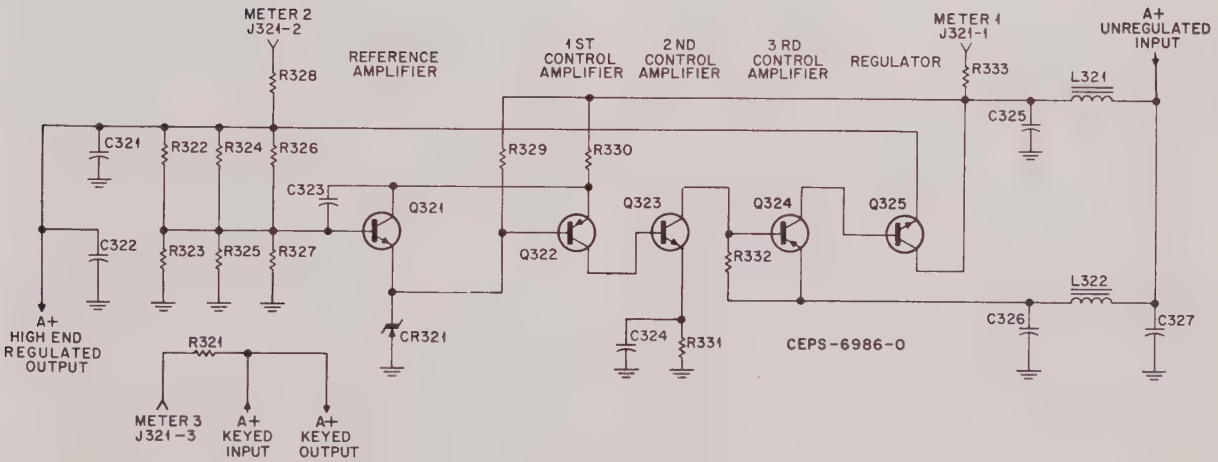


Figure 9.
Simplified High End Regulator Board

Q325 into saturation. Nearly all the input voltage is available through Q325 as power supply deck output voltage.

A voltage on Zener diode CR321 via resistor R329 causes the diode to conduct which applies 6.8 volts to the base of 1st control amplifier Q322. Since the base is then negative with respect to the emitter, the base-emitter junction is forward biased and the transistor conducts. This causes the voltage on the base of 2nd control amplifier Q323 to increase and the transistor to conduct. When Q323 conducts, the voltage on the base of 3rd control amplifier Q324 decreases, causing it to conduct, which increases the voltage on the base of regulator Q325. The voltage then present on the base of Q325 is sufficient to drive the transistor into saturation and nearly full input voltage is available as power supply output voltage (approximately 1 volt is dropped across the regulator transistor).

c. Input Voltage Greater Than 16.5 Volts

When the input voltage exceeds approximately 16.25 volts, a voltage divider network and reference amplifier circuit prevents the output from exceeding 16.25 volts. The voltage divider network consists of resistors R322 through R327 and are used to bias reference amplifier transistor Q321.

Output voltage is "monitored" by the voltage divider network and reference amplifier. As the unregulated input voltage and collector voltage of regulator transistor Q325 increases (Q325 being saturated), the voltage drop across the voltage divider increases. This increases the bias voltage to reference amplifier Q321. When the bias voltage increases to approximately 16.25 volts, Q321 becomes forward biased and the transistor begins to conduct. When Q321 conducts, emitter voltage at Q322 is decreased in proportion to Q321's collector current through resistor R330. The reduction in bias voltage is amplified through the control amplifiers and applied to Q325. Consequently, the base current of Q325 is reduced and the impedance of the series regulator transistor is increased to maintain the output voltage at approximately 16.25 volts.

NOTE

Maximum output voltage can be varied (trimmed) by changing the voltage divider network resistors as described in the following maintenance paragraphs.

d. Circuit Metering

Convenient test point monitoring capability with a Motorola portable test set is provided by metering receptacle J321.

METER POSITION	FUNCTION MONITORED
1	Board input voltage
2	Board output voltage (A+)
3	Keyed A+

9. MAINTENANCE

a. General

No routine maintenance of the power supply is required. When bench testing, the primary power source should be adjusted to 13.6 volts dc (commonly called 12-volt operation) or 72 volts dc (commonly called 64-volt operation) with the transmitter keyed. The primary power source from which the radio set normally operates should be checked to assure proper input voltage.

Refer to the MAINTENANCE section of this manual for power supply removal instructions and for the power supply troubleshooting chart.

b. Precautionary Procedures

(1) Each time the power supply deck is removed -- or power converter or regulator boards are removed from the deck individually -- there must be sufficient silicone compound at all heat sink junction surfaces. These locations are identified in the parts list photographs in this power supply section and in the maintenance section of this manual.

(2) Secure screws tightly for proper heat sinking.

(3) When replacing devices, use care not to chip the epoxy coating under transistors and inside holes. Also, be sure to replace "Teflon" tubing on each transistor lead and mounting screw.

(4) Use care not to get silicone compound on "banana" plugs. High contact resistance will cause local overheating.

(5) Always check high end regulator board output voltage each time reference amplifier transistor Q321 or Zener diode CR321 on the high end regulator board is replaced. Power supply

output should be 16.25 ±0.25 volts during standby. Refer to the following high end regulator trim procedure to adjust power supply output, should it be necessary.

(6) Be sure all power supply shields are used. This prevents danger of electrical shock and shields radiated switching noise to prevent degradation of transmitter audio characteristics.

(7) The power supply provides overvoltage and surge protection for the radio set; hence, if an external power supply is used, it must be well regulated to provide supply voltages that remain below harmful levels. The following bench supplies are approved for testing the "Micor" radio when the power supply deck is bypassed:

(a) Motorola S1303A or S1305A Regulated Power Supply.

(b) Motorola T1261A Transistorized 24-Volt to 12-Volt Converter driven by a Motorola T1012A Power Supply.

(c) 12-Volt automotive battery with a Motorola T1012A Power Supply used as a battery charger.

(8) When the heat sink deck is removed from the radio set but still used via an adapter cable, do not keep the transmitter keyed for more than 5 minutes. Then unkey for at least 20 minutes. This is necessary since most of the power supply "heat sinking" is lost when the power supply deck is removed.

c. Troubleshooting

(1) If the power converter is not running but primary voltage is present, check for a short on the output of the power supply.

(2) If the power converter stalls under transmit load, check to see if the drive control circuit is functional.

(3) Check the seating of pins inside the interconnect shells if the supply voltage is not getting through the intercabling.

(4) If the supply voltage output is half of what it should be, check rectifier diodes. One diode may be open resulting in half wave rectification.

d. High End Regulator Trim Procedure

Four resistors in the high end regulator circuit voltage divider permit adjustment of power supply output.

CAUTION

OUTPUT VOLTAGE MUST NEVER EXCEED 16.5 VOLTS (DURING TRANSMIT OR RECEIVE). ALSO, BE SURE OF METER ACCURACY AND CALIBRATION BEFORE ATTEMPTING THIS PROCEDURE.

(1) To Lower Output Voltage

Clip out resistor R325. This lowers output voltage by approximately 0.2 volt. If not enough, clip out resistor R327. This lowers output voltage approximately another 0.2 volt. Output voltage is now lowered 0.4 volt, which is maximum.

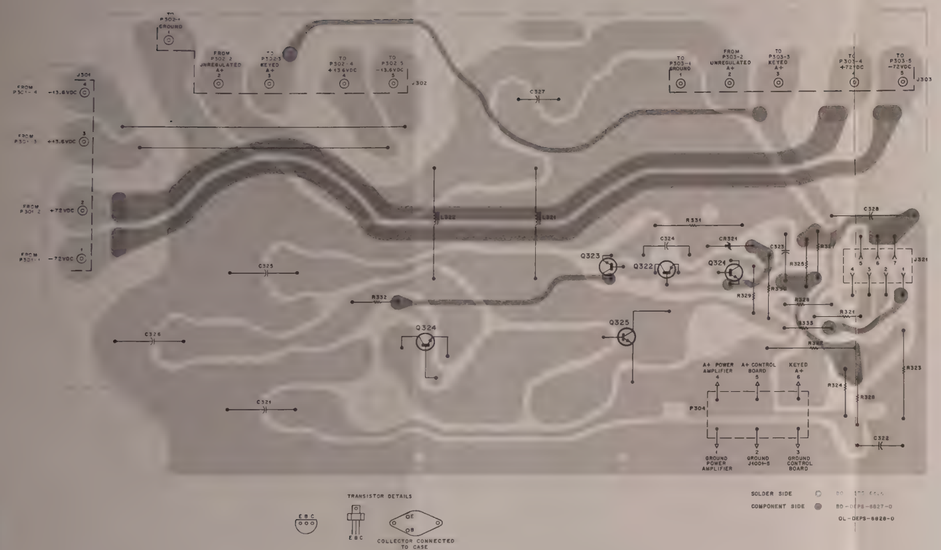
(2) To Raise Output Voltage

Clip out resistor R324. This raises output voltage by approximately 0.2 volt. If not enough, clip out resistor R326. This raises output voltage approximately another 0.2 volt. Output voltage is now raised 0.4 volt, which is maximum.

NOTE

If one each or two each of the "to lower" and "to raise" resistors are removed, the net result is no change in output voltage.

HIGH END REGULATOR BOARD



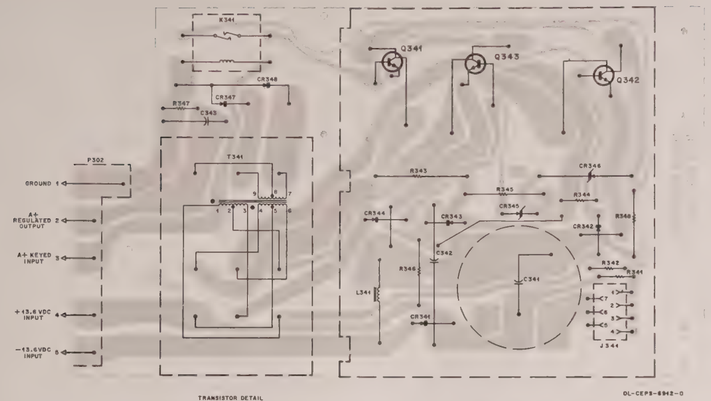
TRANSISTOR DETAILS

SOLDER SIDE
COMPONENT SIDE

80-CEPS-6827-O

OL-CEPS-6828-O

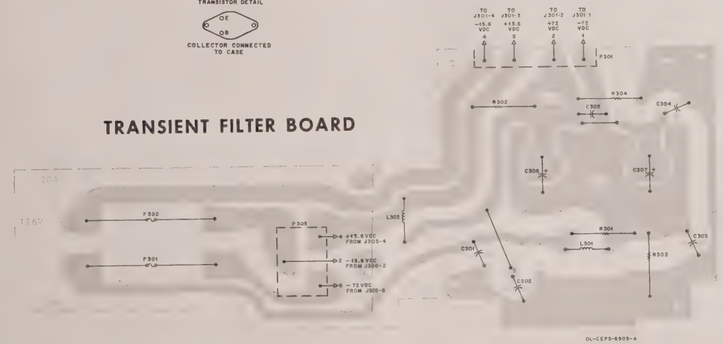
13.6 V DC POWER CONVERTER BOARD



TRANSISTOR DETAIL

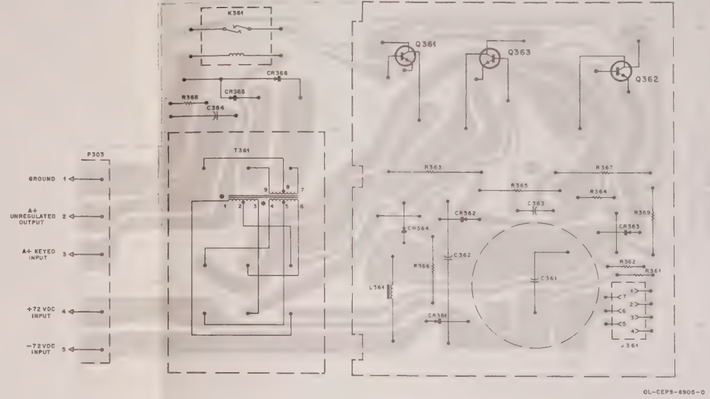
OL-CEPS-6942-O

TRANSIENT FILTER BOARD



OL-CEPS-6903-A

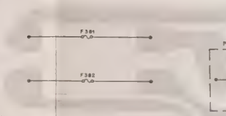
72 V DC POWER CONVERTER BOARD



TRANSISTOR DETAIL

OL-CEPS-6905-O

FUSE BOARD



OL-CEPS-6914-O

Power Supply
Schematic Diagram & Circuit Board Details
Motorola No. 68P81013E41-B
Sheet 1 of 2
7-29-74-NPC

REVISIONS

63P81013E11-D

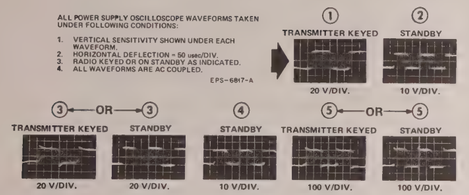
CHASSIS AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
TLN4577A-1	C302	RELOCATED. WAS CONNECTED BETWEEN C301 AND P301-3.	TRANSIENT FILTER BD.

POWER SUPPLY WAVEFORMS

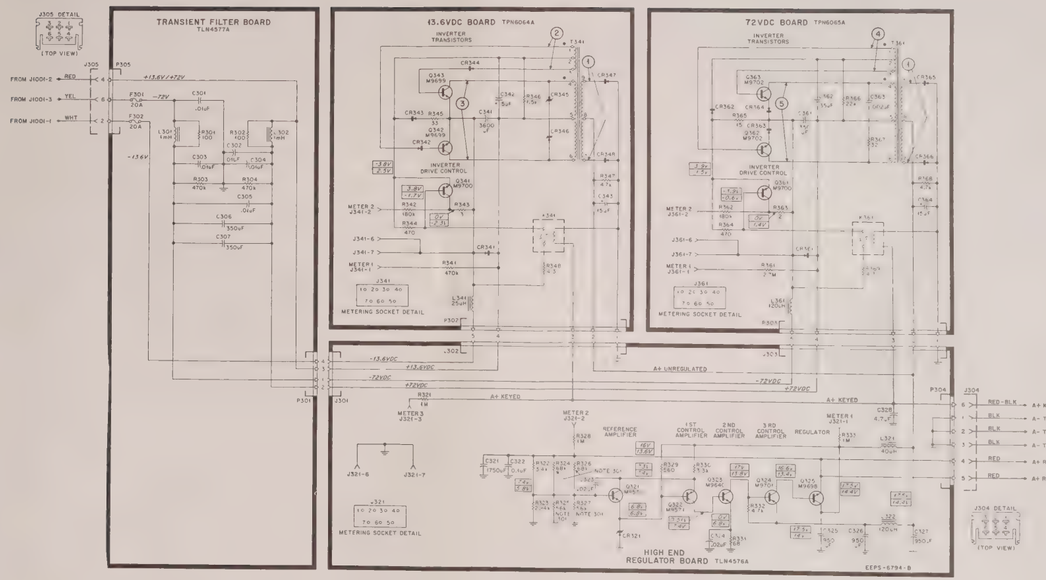
ALL POWER SUPPLY OSCILLOSCOPE WAVEFORMS TAKEN UNDER FOLLOWING CONDITIONS:

1. VERTICAL SENSITIVITY SHOWN UNDER EACH WAVEFORM.
2. HORIZONTAL DEFLECTION - 50 usec/DIV.
3. RADIO KEYED OR ON STANDBY AS INDICATED.
4. ALL WAVEFORMS ARE AC COUPLED.

EPS-6817-A



POWER SUPPLY



NOTES

381. REFER TO MAINTENANCE INFORMATION IN THIS SECTION FOR COMPONENT VALUE SELECTION. VOLTAGE MEASUREMENTS ARE FOR DC VOLTAGES MEASURED WITH AN 11 MEGOHM INPUT RESISTANCE VOLTMETER WITH RESPECT TO CHASSIS GROUND. VOLTAGE MEASURED IN:

STANDBY MODE
TRANSMIT MODE

383. UNLESS OTHERWISE STATED, CAPACITOR VALUES ARE IN MICROFARADS.

EPS-7101-O

PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

Power Supply
Schematic Diagram & Circuit Board Details
Motorola No. 63P81013E11-B
(Sheet 2 of 2)
7/29/74-NPC

ELECTRICAL PARTS LIST

IMPORTANT

USE ONLY THE FOLLOWING MOTOROLA PART NUMBERS WHEN ORDERING REPLACEMENT PARTS

Power Supply PL-1299-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
C301 thru 306	21-8359cE15	CAPACITOR, fixed: uF .01 ±20% 3000 V does not include 42B9401-C01 RETAINER
C305	21-8359cE20	.01 ±20% 1000 V
C306, 307	23-8308JG16	350-250-100-50 V
C321	23-8303G16	1750-150-10% 25 V
C322	8-8290S280	0.1+80%-50 V
C323, 324	8-8290S023	.02 ±10% 100 V
C325, 326, 327	23-8303G17	950-150-10% 30 V
C328	23-8324C15	4, 7 ±20% 25 V
C341	23-8303G15	3600-150-10% 25 V
C342	23-8307C08	5-150-10% 300 V
C343	23-8324C32	15 ±20% 25 V
C361	23-8303G16	350-100-10% 150 V
C362	23-8301A13	35-100-10% 100 V
C363	21-8374c	.002 ±10% 500 V
C364	23-8324C02	15 ±20% 25 V
CR321	48-8225cC47	SEMICONDUCTOR DEVICE (note, SEE NOTE) silicon, Zener type, 6.8 V ±5%
CR343 thru 344	48-8252SG13	1-2 A silicon
CR345, 346	48-8349E30	silicon Zener type, 51 V
CR347, 348	48-8252SG14	silicon
CR361, 362	48-8252SG14	silicon
CR363, 364	48-8252SG13	silicon
CR365, 366	48-8252SG15	silicon
CR391	48-8252SG13	silicon
F301, 302, 381, 383, 391	65-135011	FUSE, cartridge 20 A 250 V
J301, 302, 303		CONNECTOR, receptacle consists of female contact terminals (Part No. 9A84041D01 mounted on edge of circuit board
J321, 341, 361	9-84207B01	female, 7-contact
K343, 363	80-84157B04	RELAY, magnetic reed 12 V dc 1 form A coil res 80 ohms ±10%
K391	80-84117D01	RELAY, armature 4 form C coil res 51 ohms ±5% does not include 19C840951D01 COVER
L301, 302	25-84028D01	REACTOR, AF, choke 2 mH res 0.2 ohms max.
L321	24-8260cB03	40 uH, res .032 ohms max.
L322	24-8260cB01	120 uH, res .065 ohms max.
L341	24-8260cB04	45 uH, .018 ohms max.
L361	24-8260cB01	120 uH, res .065 ohms max.
P301, 302, 303		CONNECTOR, plug consists of male contact terminals mounted on circuit board - banana type (Part No. 28B846D9D01 consists of male contact terminals - tap type Part No. 19S10061A05)
P304, 305		
Q321	48-869570	TRANSISTOR (SEE NOTE N-P-N, type M9572
Q322	48-869571	P-N-P type M9571
Q323	48-869640	N-P-N, type M9642
Q324	48-869701	P-N-P type M9701
Q325	48-869698	N-P-N type M9698
Q341	48-869700	N-P-N, type M9700
Q342, 343	48-869699	N-P-N, type M9699
Q361	48-869700	N-P-N, type M9700
Q362, 363	48-869702	N-P-N, type M9702
R301, 302	6-3963	RESISTOR, fixed ±10%, 1/4 W unl. stated 100, 2 W
R303, 304	6-2080	470k, 2 W
R321	6-129189	1 meg ±5%
R322	6-82810D19	3, 4k ±1%, 1/2 W
R323	6-82810D11	2, 94k ±1%, 1/2 W
R324	6-129299	68k ±5%
R325	6-128684	56k ±5%
R326	6-129299	68k ±5%
R327	6-128684	56k ±5%
R328	6-129189	1 meg ±5%
R329	6-6291	5k0, 1/2 W
R330	6-129231	3, 3k
R331	6-2032	68, 1 W
R332	6-127804	4, 7k
R333	6-129189	1 meg ±5%
R341	6-129349	470k ±5%
R342	6-129229	180k ±5%
R343	17-82477B01	3, 5 W
R344	6-127801	470
R345	6-498016	33: 2 W
R346	6-5700	1, 5k, 1 W
R347	6-127604	4, 7k
R348	17-82036C09	4, 3, 2 W
R361	6-129239	2, 7 meg ±5%
R362	6-129229	180k ±5%
R363	17-82477B53	2, 5 W
R364	6-127801	470
R365	6-476059	15, 2W
R366	6-6341	22k, 1 W
R367	17-82477B02	32 ±5%, 5 W
R368	6-127804	4, 7k
R369	17-8203cC09	4, 3 ±5%; 2 W
T341	25-84016D01	TRANSFORMER, power-transistor-controlled, operating from 13, 6 V dc power source; center-tapped primary, secondary and feedback windings
T361	25-84015D01	transistor-controlled, operating from 72 V dc power source; center-tapped primary, secondary and feedback windings
XF301, 302, 381, 382, 391		FUSEHOLDER, consists of two fuse-mounting clips (Part No. 42B84027D11) mounted on circuit board

NOTE:

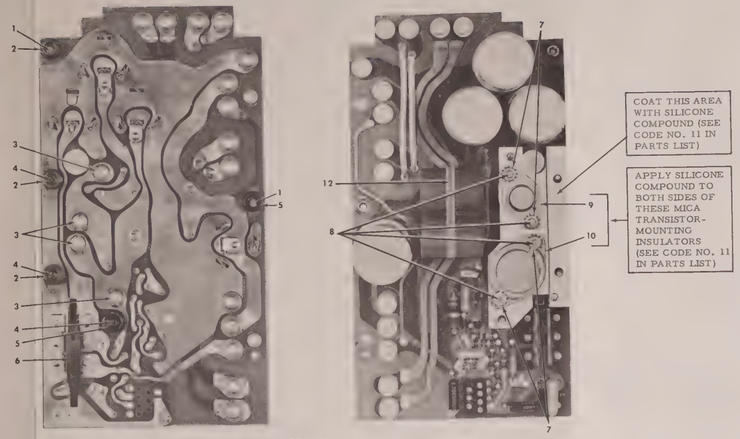
Replacement diodes and transistors must be ordered by Motorola part number only for optimum performance.

Power Supply
Parts List
Motorola No. PEPS-7119-C
Sheet 1 of 2
7-25-74PC

27-14

POWER SUPPLY

HIGH END REGULATOR BOARD



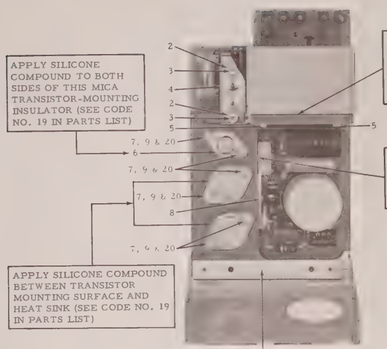
BEPS-7104-A

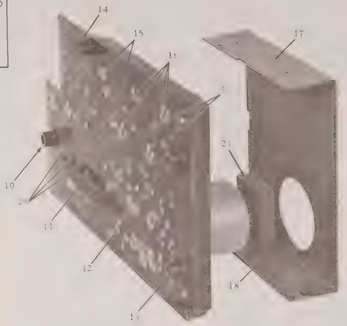
MECHANICAL PARTS LIST

TLN4576A High End Regulator Board PL-1338-B

CODE	MOTOROLA PART NO.	DESCRIPTION
1	3-136932	SCREW, tapping: 4-40 x 3/8" Phillips round head (w/ext. lockwasher); 2 required
2	42-84284B02	RETAINER, screw: (RED); 3 required
3	3-138505	SCREW, machine: 6-32 x 9/16" slotted binder head; 4 required
4	3-138507	SCREW, tapping: 4-40 x 9/16" Phillips round head (w/ext. lockwasher); 3 required
5	42-84284B01	RETAINER, screw: (BLK); 2 required
6	55-84300B02	HANDLE, flat plastic: retractable
7	4-7666	LOCKWASHER: No. 6 external; 4 required
8	2-7005	NUT, machine: 6-32 x 1/4" hex; 4 required
9	14-83575A01	INSULATOR, transistor mounting (mica)
10	14-865854	INSULATOR, transistor mounting (mica)
11	11-834678	SILICONE COMPOUND: 1/4 oz. tube
	or11-490487	SILICONE COMPOUND: 8 oz. tube
12	42-83553G01	STRAP, mounting

13.6 V DC POWER CONVERTER BOARD





BEPS-7106-B

PARTS LIST

TPN6064A 13.6-Volt Power Supply PL-1337-B

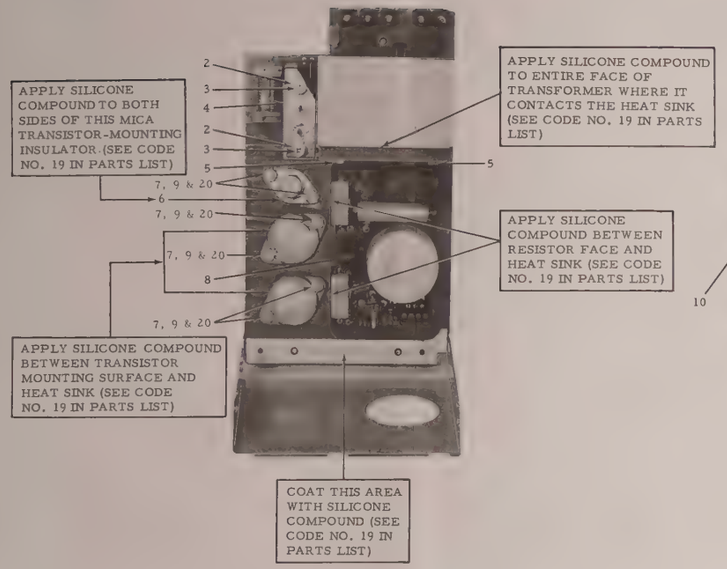
CODE	MOTOROLA PART NO.	DESCRIPTION
1	64-8403cD01	BRACKET, diode mounting and heat sink
-	4-10057A04	WASHER, insulating: shoulder type
-	3-134268	SCREW, tapping: 4-40 x 7/16" Phillips hex head (w/int. lockwasher); 2 required
4	14-84038D01	INSULATOR (mylar)
5	3-135664	SCREW, tapping: 6-32 x 9/16" Phillips hex head (w/ext. lockwasher); 2 required
-	14-81575A01	INSULATOR, transistor mounting (Mica)
-	2-7005	NUT, machine: 6-32 x 1/4" hex; 6 required
8	42-84049D01	BRACKET, resistor retaining
-	4-7666	LOCKWASHER: No. 6 external; 6 required
10	3-138517	SCREW, tapping: 4-40 x 7/16" Phillips round head (w/ext. lockwasher)
11	55-84300B01	HANDLE, flat plastic: retractable
-	3-138515	SCREW, tapping: 4-40 x 5/8" Phillips round head (w/ext. lockwasher); 3 required
-	42-84284B02	RETAINER, screw: (RED); 2 required
14	42-84284B01	RETAINER, screw: (BLK); 2 required
15	3-138616	SCREW, machine: 6-32 x 3/4" slotted binder head; 2 required
16	3-138616	SCREW, machine: 6-32 x 3/4" slotted binder head; 4 required
17	26-8406cD01	SHIELD
18	14-84094D01	INSULATOR, shield
19	11-834678	SILICONE COMPOUND: 1/4 oz. tube
	or11-490487	SILICONE COMPOUND: 8 oz. tube
20	37-122979	TUBING, Teflon: No. 7 (Natural)
21	75-83778F01	PAD, hold-down

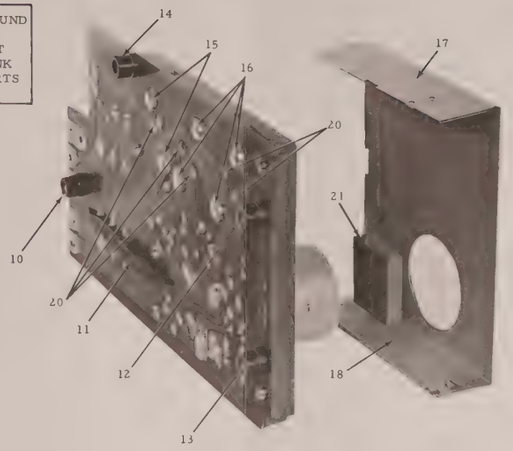
72 V DC POWER CONVERTER BOARD

PARTS LIST

TPN6668A 72-Volt Power Supply
TPN6668A 110-Volt Power Supply PL-1336-C

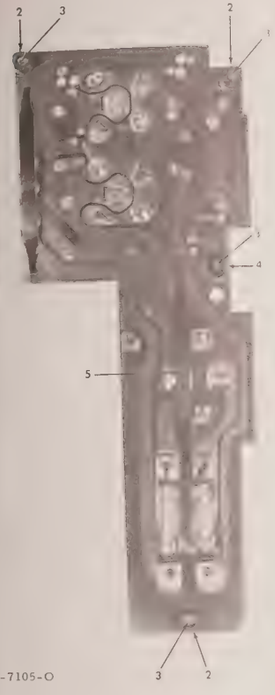
CODE	MOTOROLA PART NO.	DESCRIPTION
1	54-84034B01	BRACKET, diode mounting and heat sink
2	4-10057A94	WASHER, insulating: shoulder type
3	3-134268	SCREW, tapping: 4-40 x 7/16" Phillips hex head (w/int. lock-washer); 2 required
4	14-84038D01	INSULATOR (mylar)
5	3-135664	SCREW, tapping: 6-32 x 9/16" Phillips hex head (w/ext. lock-washer); 2 required
6	14-83575A01	INSULATOR, transistor, mounting (Mica)
7	2-7005	NUT, machine: 6-32 x 1/4" hex; 6 required
8	42-84043D01	BRACKET, resistor retaining
9	4-7666	LOCKWASHER: No. 6 external; 6 required
10	3-138517	SCREW, tapping: 4-40 x 7/16" Phillips round head (w/ext. lockwasher)
11	55-84300B01	HANDLE, flat plastic: retract-able
12	3-138515	SCREW, tapping: 4-40 x 5/8" Phillips round head (w/ext. lockwasher); 3 required
13	42-84284B02	RETAINER, screw: (RED); 2 required
14	42-84284B01	RETAINER, screw: (BLK); 2 required
15	3-138505	SCREW, machine: 6-32 x 9/16" slotted binder head; 2 required
16	3-138512	SCREW, machine: 6-32 x 5/8" slotted binder head; 4 required
17	26-84067D01	SHIELD
18	14-84094D01	INSULATOR, shield
19	11-84478	SILICONE COMPOUND: 1/4 oz. tube
	or 11-490487	SILICONE COMPOUND: 8 oz. tube
20	37-122979	TUBING, Teflon: No. 7 (Natural)
21	75-83778F01	PAD, hold-down



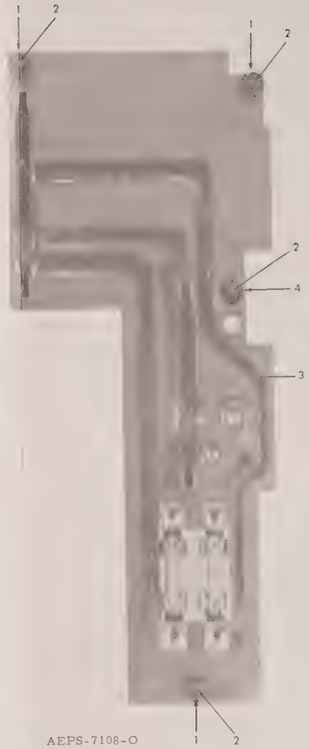


BEPS-7107-B

TRANSIENT FILTER BOARD



AEPS-7105-O



AEPS-7108-O

PARTS LIST

TLN4577A Transient Filter Board PL-1340-A

CODE	MOTOROLA PART NO.	DESCRIPTION
1	42-84030D01	RETAINER, capacitor
2	42-84027D01	CLIP, fuse-mounting
2	42-84284B02	RETAINER, screw: (RED); 3 required
3	3-136932	SCREW, tapping: 4-40 x 3/8" Phillips round head (w/ext. lockwasher); 4 required
4	42-284B01	RETAINER, screw: (BLK)
5	55-84300B01	HANDLE, flat plastic: retractable

PARTS LIST

TLN4578A Fuse Board PL-1341-A

CODE	MOTOROLA PART NO.	DESCRIPTION
1	42-84284B02	RETAINER, screw: (RED); 1 required
2	3-138162	SCREW, tapping: 4-40 x 3/8" Phillips round head (w/ext. lockwasher); 4 required
3	55-84300B01	HANDLE, flat plastic: retractable
4	42-84284B01	RETAINER, screw: (BLK)

1. CIRCUIT BOARDS USED

APPLICATION	TLN4838A 117 V AC Rectifier & Filter Board	TPN6068A 110 V DC Power Converter Board	TLN4871A Strapping Board	TLN4576A High End Regulator
117 V AC	X	X		X
13.6 V DC (Emergency)	X		X	X

2. TECHNICAL CHARACTERISTICS

INPUT VOLTAGES	94 to 140 volts (117 V RMS Nominal) 10.9 to 18.0 volts (13.6 volts Nominal)
OUTPUT VOLTAGE AT NOMINAL INPUT	13.6 volt @ 10 amps (transmit and 117 V AC operation)
HIGH END REGULATION POINT	16.25 volts ±.25 volts
MAXIMUM OUTPUT CURRENT	14 amps (converter stalls if current exceeds this value)
AMBIENT TEMPERATURE RANGE	-30°C to +65°C

MOTOROLA INC. Communications Division
ENGINEERING PUBLICATIONS 1301 E. ALGONQUIN ROAD SCHAUMBURG, ILLINOIS 60172

3. DESCRIPTION

The 117 V AC power supply deck permits the radio set to operate from either a 117 V AC power source or a 13.6 V DC emergency source. It consists of a rectifier-filter board, a 110 V DC power converter board, a 13.6 V DC strapping board, and a high end regulator board. With 117 V AC operation, the primary input voltage is floating but proper polarity must be observed. In the case of 117 V AC failure, the radio can be operated from a 13.6 V DC negative ground system.

The interconnected, plug-in circuit boards which are mounted on the bottom side of the radio can be removed individually or as a unit. They are removed individually by loosening the captive screws associated with the specific board, or as a unit by loosening the red captive screws around the perimeter of the deck.

CAUTION

To prevent power supply damage, thermal compound must be used between the surfaces indicated on the mechanical parts list photographs in this section and in the MAINTENANCE section of this manual.

The input ac voltage to the power supply deck is rectified and filtered at the rectifier board and routed to the power converter board where it is stepped-down to a specific voltage range. The output voltage from the converter board is applied to the high and regulator board which limits the A+ voltage to a specific maximum output level.

Metering receptacles are provided on all boards to facilitate rapid localization and identification of malfunction to a specific circuit board and area.

4. RECTIFIER-FILTER BOARD

This circuit board has a threefold function: it rectifies and fuses the primary ac voltage, filters the pulsating voltage in two stages and protects the voltage sensitive components from lightning spikes impressed on ac lines.

a. Rectification and Fusing

Full wave rectification is accomplished by a diode bridge (CR310, CR311, CR312 and CR313). Fuse F310 provides protection against accidental grounding of the (hot) ac line or an extreme overload at the output of this board.

b. Filtering

The pulsating voltage is filtered by an inductance input L-C ripple filter (L310, C310 and C311). Additional filtering is accomplished by electronic filter stage Q311, C312, R313 and R317. This stage is protected against turn-on transients and overload by Q310, CR314, CR315, CR317, R312, R311, R316 and R315.

c. Lightning Protection

Voltage transient spikes up to 1500 V peak and 55 Jules of energy present on AC lines can be safely absorbed by the diode bridge, varistor (RV310) and fuse (F310) combination.

d. Circuit Metering

Convenient test point monitoring capability with a Motorola portable test set is provided by metering receptacle J310.

METER POSITION	FUNCTION MONITORED
1	Rectified Primary Voltage
2	Output Ripple

5. 110 V DC POWER CONVERTER BOARD

a. General

This circuit board is a dc to dc converter which supplies a nominal 23.9 volts dc (transmitter unkeyed) or a nominal 14.8 volts dc (transmitter keyed) to the regulator board from a nominal 146 V DC transmitter unkeyed or a 101 V DC transmitter keyed input. This is accomplished by an inverter circuit (free running multivibrator) which develops an alternating voltage, then rectifying the alternating voltage to produce a positive dc output. An inverter drive control circuit is used to provide more current output when the transmitter is keyed. Inherent short circuit protection prevents power supply damage if the current demand exceeds 14 amperes.

b. Inverter Circuit

The inverter circuit is a free running multivibrator which operates at approximately 5 kHz. The circuit consists of transistors Q380 and Q381, saturable core transformer T380 and associated components. The negative polarity of the rectified and filtered ac voltage (110 V) is applied to the emitters of Q380 and Q381; the positive polarity is applied to the collectors through transformer T380. The starting voltage is applied to both transistors, but slight imbalance will cause one

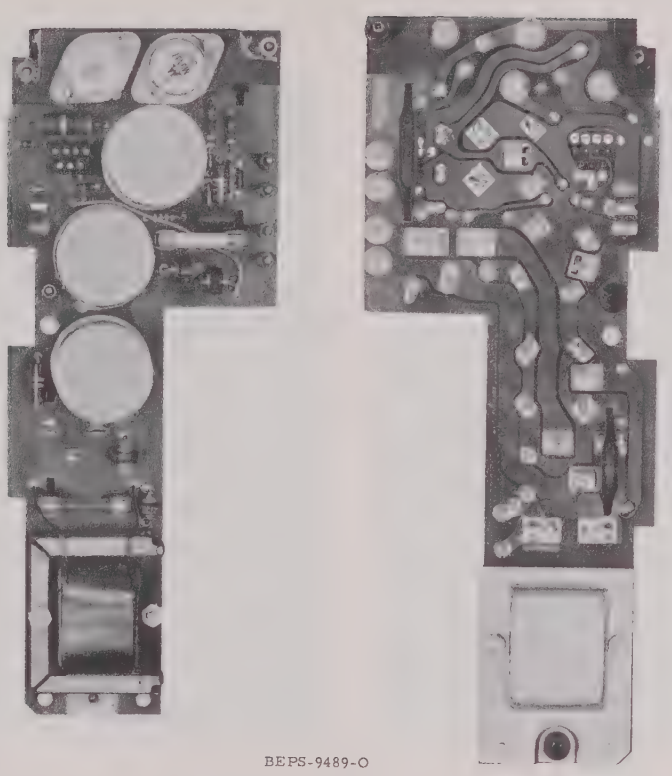


Figure 1.
Rectifier and Filter Board

transistor to conduct before the other. Assume Q380 conducts first. The resulting increase in Q380 collector current through the primary of the transformer induces a voltage in the feedback winding of the correct polarity to cause Q380 to be driven to saturation and Q381 to be driven to cutoff. As the transformer saturates, causing no change in flux density, the drive to the base of Q380 is reduced and its collector current begins to decrease. This causes a change in flux density in the opposite direction that drives Q380 into cutoff and Q381 into saturation. The action repeats with Q380 and Q381 alternately conducting, thus developing an alternating voltage across the secondary (output) winding of transformer T380.

Coil L380 prevents high frequency components created by transistor switching action from conducting into the input supply lines. Capacitor C382 and resistor R382 is a voltage despiking network which limits the collector-to-emitter voltage of both inverter transistors to a safe value.

c. Rectifier-Filter Circuit

The peak-to-peak voltage developed across the primary of transformer T380 is approximately four-times the input voltage to the circuit board. The center tapped step-down secondary and diodes CR383 and CR384 provide full wave rectification while resistor R385 and capacitor C383 filter high frequency switching components. The dc output voltage varies directly with the input voltage; that is, the output voltage of the converter increases when the input voltage increases and vice versa.

d. Inverter-Drive Control Circuit

When the transmitter is keyed additional current capability is provided by increased feedback voltage to the switching transistors. Keyed A+ energizes relay K380, which then applies forward bias to and saturates inverter drive control transistor Q382. Resistor R384 is placed in parallel with resistor R380, providing greater base drive to inverter transistors Q380 and Q381.

e. Short Circuit Protection Circuit

Operating characteristics of the converters provide self-protection in case a short circuit develops in the power supply load. A short circuit causes a heavy current demand and the inverter circuit stops switching due to loss of feedback. When switching action stops, capacitor C381 (which

provided a low impedance path for initial start up) will charge up and limit the base current of the switching transistors to a safe level. The inverter circuit may not be self-starting after a short circuit has been removed. To restart the inverter circuit, it may be necessary to turn off and then restore power.

f. Circuit Metering

Convenient test point monitoring capability with a Motorola portable test set is provided by metering receptacle J380.

METER POSITION	FUNCTION MONITORED
1	Input primary voltage
2	Drive control transistor collector

6. HIGH END REGULATOR BOARD

a. General

The voltage output of the power supply deck is nearly the same as its input voltage as long as the input voltage is below 16.5 volts. When the input voltage is higher, the high end regulator board restricts power supply deck output to 16.25 ±0.25 volt.

b. Input Voltage Less Than 16.25 Volts (Approx.)

When the input voltage is applied to the high end regulator board, all of the control amplifier transistors conduct, driving regulator transistor Q325 into saturation. Nearly all the input voltage is available through Q325 as power supply deck output voltage.

A voltage on Zener diode CR321 via resistor R329 causes the diode to conduct which applies 6.8 volts to the base of 1st control amplifier Q322. Since the base is then negative with respect to the emitter, the base-emitter junction is forward biased and the transistor conducts. This causes the voltage on the base of 2nd control amplifier Q323 to increase and the transistor to conduct. When Q323 conducts, the voltage on the base of 3rd control amplifier Q324 decreases, causing it to conduct, which increases the voltage on the base of regulator Q325. The voltage then present on the base of Q325 is sufficient to drive the transistor into saturation and nearly full input voltage is available as power supply output voltage (approximately 1 volt is dropped across the regulator transistor).

c. Input Voltage Greater Than 16.25 Volts

When the input voltage exceeds approximately 16.25 volts, a voltage divider network and reference

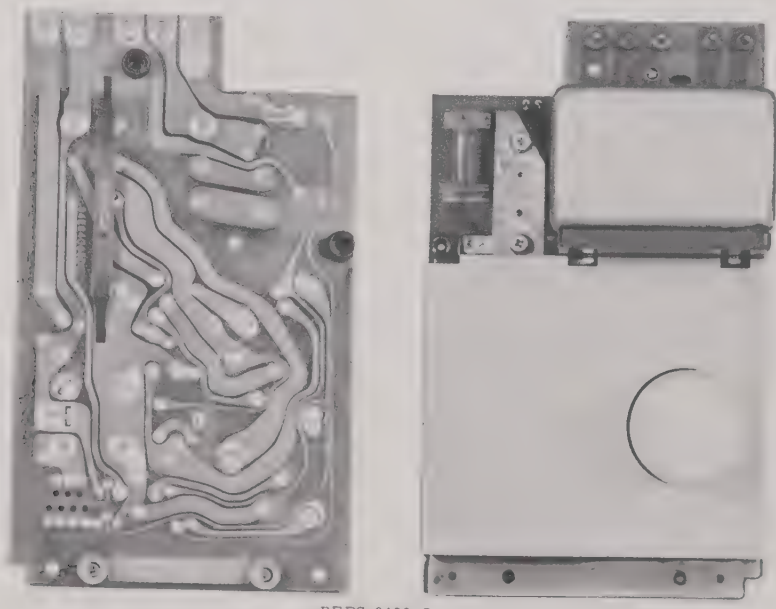


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Figure 2.
110 V DC Power Converter Board

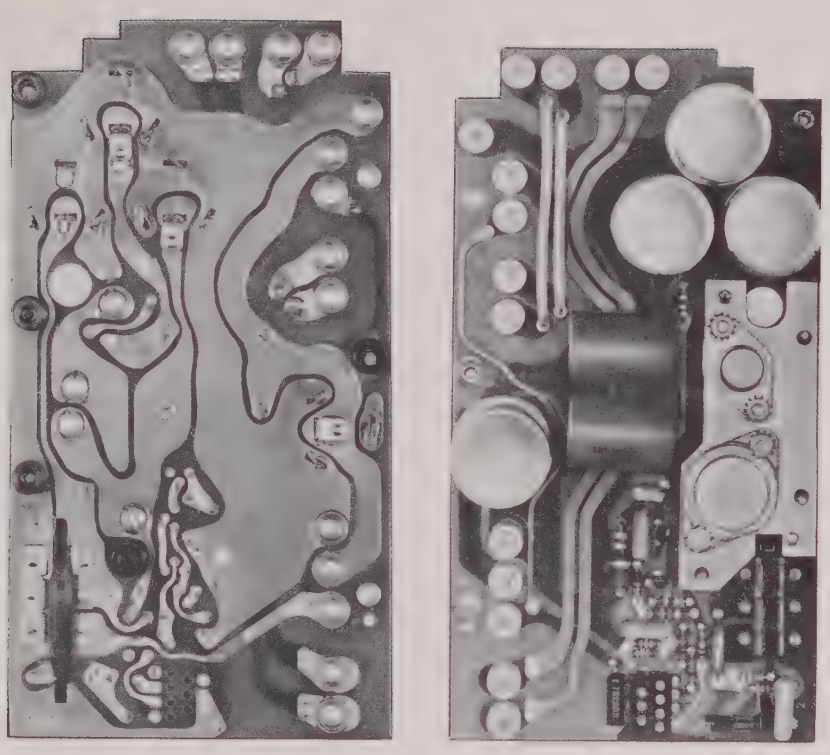

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Figure 3.
High-End Regulator Board

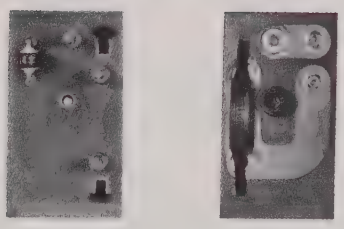

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Figure 4.
Strapping Board

amplifier circuit prevents the output from exceeding 16.25 volts. The voltage divider network consists of resistors R322 through R327 and are used to bias reference amplifier transistor Q321.

Output voltage is "monitored" by the voltage divider network and reference amplifier. As the unregulated input voltage and collector voltage of regulator transistor Q325 increases (Q325 being saturated), the voltage drop across the voltage divider increases. This increases the bias voltage to reference amplifier Q321. When the bias voltage increases to approximately 16.25 volts, Q321 becomes forward biased and the transistor begins to conduct. When Q321 conducts, emitter voltage at Q322 is decreased in proportion to Q321's collector current through resistor R330. The reduction in bias voltage is amplified through the control amplifiers and applied to Q325. Consequently, the base current of Q325 is reduced and the impedance of the series regulator transistor is increased to maintain the output voltage at approximately 16.25 volts.

NOTE

Maximum output voltage can be varied (trimmed) by changing the voltage divider network resistors as described in the following maintenance paragraphs.

d. Circuit Metering

Convenient test point monitoring capability with a Motorola portable test set is provided by metering receptacle J321.

METER POSITION	FUNCTION MONITORED
1	Board input voltage
2	Board output voltage (A+)
3	Keyed A+

7. MAINTENANCE

a. General

No routine maintenance of the power supply is required. When bench testing, the primary power source (variable voltage transformer) should be adjusted to 117 V (RMS) or 13.6 volts dc (when emergency power is used) with the transmitter keyed. The primary power source from which the radio set normally operates should be checked to assure proper input voltage.

Refer to the MAINTENANCE section of this manual for power supply removal instructions and for the power supply troubleshooting chart.

b. Precautionary Procedures

(1) Each time the power supply deck is removed -- or power converter or regulator boards are removed from the deck individually -- there must be sufficient thermal compound at all heat sink junction surfaces. These locations are identified in the parts list photographs in this power supply section and in the maintenance section of this manual.

(2) Secure screws tightly for proper heat sinking.

(3) When replacing devices, use care not to chip the epoxy coating under transistors and inside holes.

(4) Use care not to get silicone compound on "banana" plugs. High contact resistance will cause local overheating.

(5) Always check high end regulator board output voltage each time reference amplifier transistor Q321 or Zener diode CR321 on the high end regulator board is replaced. Power supply output should be 16.25 ±0.25 volts during standby. Refer to the following high end regulator trim procedure to adjust power supply output, should it be necessary.

(6) Be sure all power supply shields are used. This prevents danger of electrical shock and shields radiated switching noise to prevent degradation of transmitter audio characteristics.

(7) The power supply provides overvoltage and surge protection for the radio set; hence, if an external power supply is used, it must be well regulated to provide supply voltages that remain below harmful levels.. The following bench supplies are approved for testing the "Micor" radio when the power supply deck is bypassed:

(a) Motorola S1303A or S1305A Regulated Power Supply.

(b) Motorola T1261A Transistorized 24-Volt to 12-Volt Converter driven by a Motorola T1012A Power Supply.

(c) 12-Volt automotive battery with a Motorola T1012A Power Supply used as a battery charger.

(8) When the heat sink deck is removed from the radio set but still used via an adapter cable, do not keep the transmitter keyed for more than 5 minutes. Then unkey for at least 20 minutes. This is necessary since most of the power supply "heat sinking" is lost when the power supply deck is removed.

c. Troubleshooting

(1) If the power converter is not running but primary voltage is present, check for a short on the output of the power supply.

(2) If the primary fuse is blown, check the bridge diodes and/or the varister for shorts.

(3) If the power converter stalls under transmit load, check to see if the drive control circuit is functional.

(4) Check the seating of pins inside the interconnect shells if the supply voltage is not getting through the intercabling.

(5) If the supply voltage output is half of what it should be, check rectifier diodes. One diode may be open resulting in half wave rectification.

d. High End Regulator Trim Procedure

Four resistors in the high end regulator circuit voltage divider permit adjustment of power supply output.

CAUTION

Output voltage must never exceed 16.5 volts (during transmit or receive). Also, be sure of meter accuracy and calibration before attempting this procedure.

(1) To Lower Output Voltage

Clip out resistor R325. This lowers output voltage by approximately 0.2 volt . If not enough, clip out resistor R327. This lowers output voltage approximately another 0.2 volt. Output voltage is now lowered 0.4 volt, which is maximum.

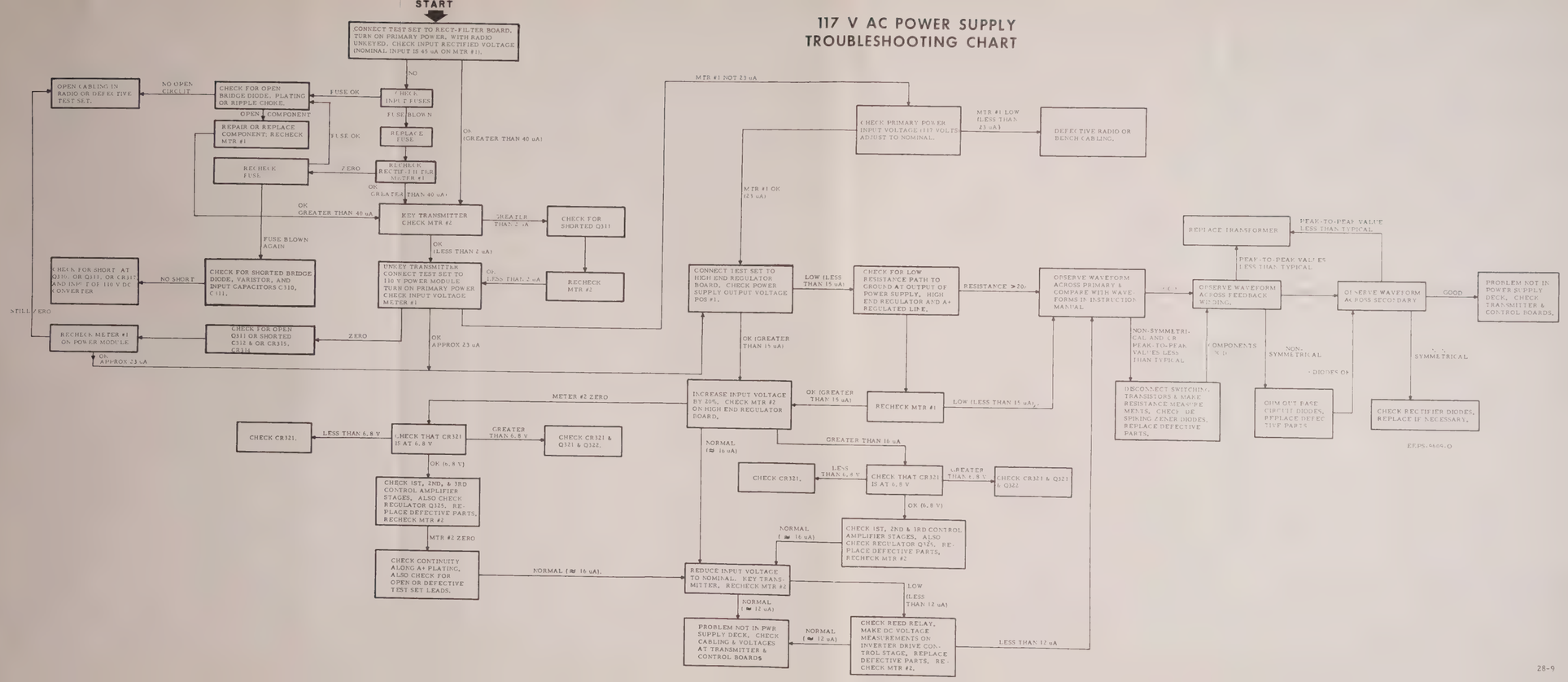
(2) To Raise Output Voltage

Clip out resistor R324. This raises output voltage by approximately 0.2 volt. If not enough, clip out resistor R326. This raises output voltage approximately another 0.2 volt. Output voltage is now raised 0.4 volt, which is maximum.

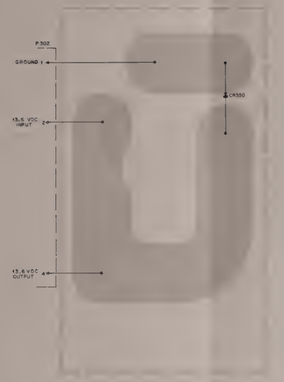
NOTE

If one each or two each of the "to lower" and "to raise" resistors are removed, the net result is no change in output voltage.

117 V AC POWER SUPPLY TROUBLESHOOTING CHART



STRAPPING BOARD



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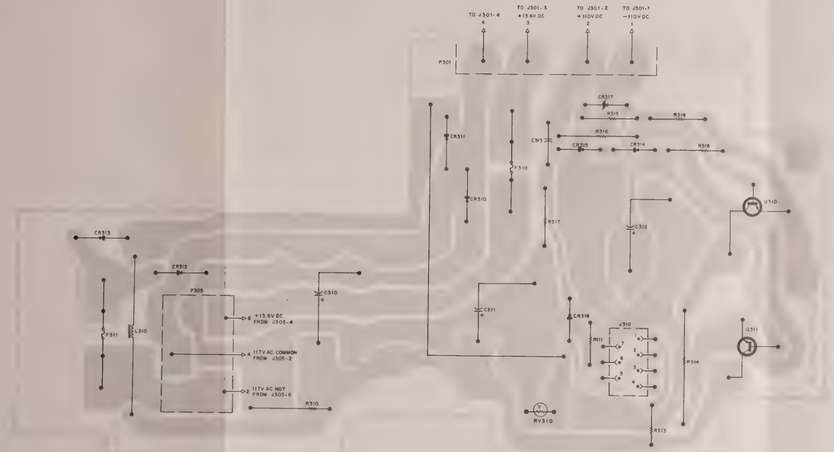
RECTIFIER AND FILTER BOARD



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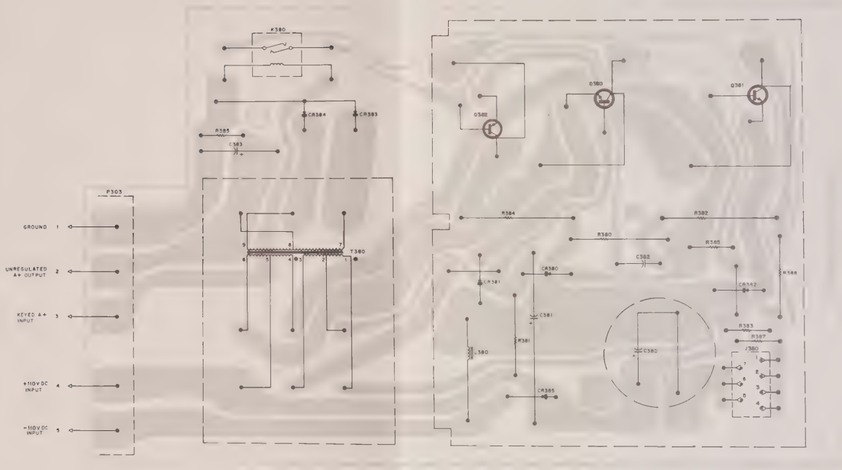
110 V DC POWER CONVERTER BOARD



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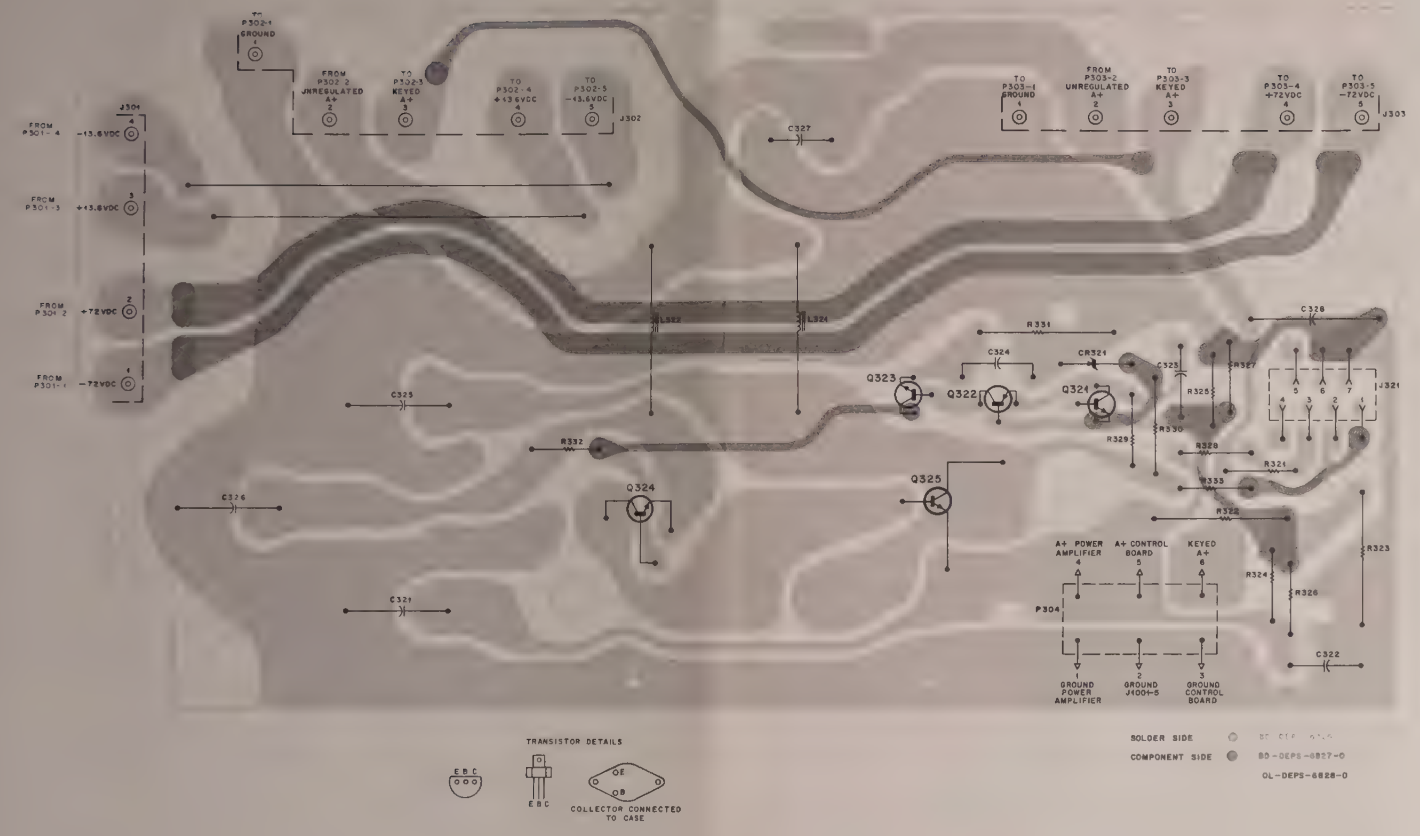
POWER SUPPLY

117 V AC Power Supply
Schematic Diagram and
Circuit Board Detail
Motorola No. PEPS-9492-B
(Sheet 1 of 2)
7/29/74-NPC

HIGH END REGULATOR BOARD



NOTES

301. REFER TO MAINTENANCE INFORMATION IN THIS SECTION FOR COMPONENT VALUE SELECTION.
302. VOLTAGE MEASUREMENTS ARE FOR DC VOLTAGES MEASURED WITH A 11 MEGOHM INPUT RESISTANCE VOLTMETER WITH RESPECT TO CHASSIS GROUND VOLTAGE MEASURED IN:

___ V	STANDBY MODE
___ V	TRANSMIT MODE

303. UNLESS OTHERWISE STATED, CAPACITOR VALUES ARE IN PICOFARADS.

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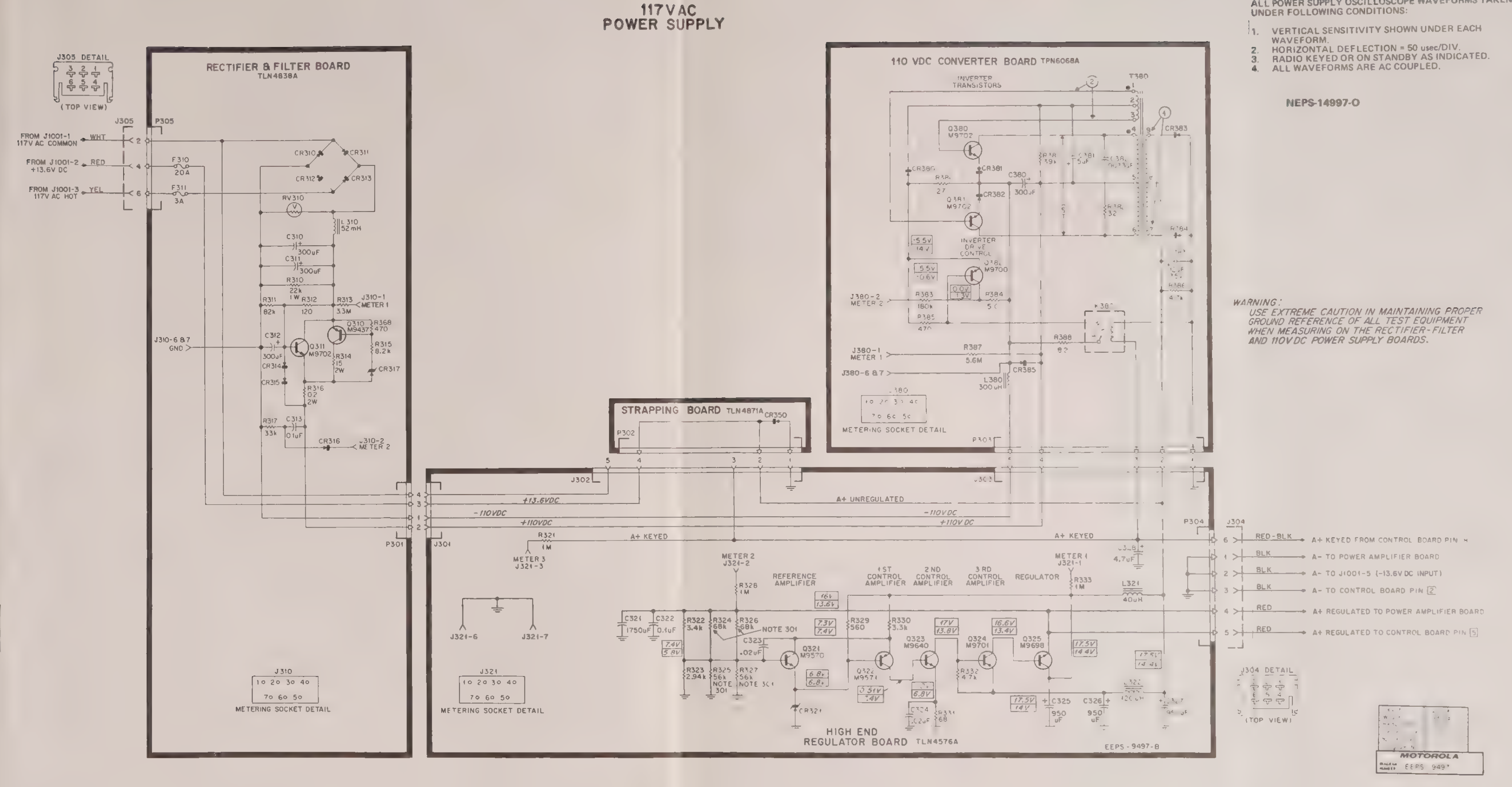
117 V AC POWER SUPPLY



ALL POWER SUPPLY OSCILLOSCOPE WAVEFORMS TAKEN UNDER FOLLOWING CONDITIONS:

1. VERTICAL SENSITIVITY SHOWN UNDER EACH WAVEFORM.
2. HORIZONTAL DEFLECTION = 50 usec/DIV.
3. RADIO KEYED OR ON STANDBY AS INDICATED.
4. ALL WAVEFORMS ARE AC COUPLED.

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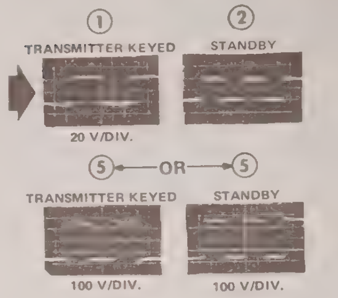
POWER SUPPLY WAVEFORMS



117 V AC Power Supply
Schematic Diagram and
Circuit Board Detail
Motorola No. PEPS-9492-B
(Sheet 2 of 2)
7/29/74-NPC

REFERENCE SYMBOL	MOTOROLA PART NO	DESCRIPTION

ELECTRICAL PARTS LIST

TLN[illegible]A Rectifier Filter Board PL-1348-A

		CAPACITOR, fixed: uF
C[illegible] thru [illegible]12	[illegible]G[illegible]	[illegible]
C[illegible]	[illegible]G[illegible]	[illegible] 1 ±1%, 200 V
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR[illegible] thru [illegible]	48-[illegible]G14	silicon
CR[illegible]	48-[illegible]H1[illegible]	silicon
CR[illegible]	48-[illegible]B[illegible]	silicon
CR[illegible]	48-[illegible]C14	Zener
		FUSE, cartridge
F[illegible]	[illegible]	2 A, [illegible] V
F[illegible]	[illegible]	[illegible] A, [illegible] V
		CONNECTOR, receptacle
J[illegible]	[illegible]-842[illegible]B[illegible]	[illegible] contact
		CHOKE, filter:
L[illegible]	25-84626E01	82 mH
		CONNECTOR, plug
P[illegible]		consists of: [illegible]-[illegible]D[illegible] CONTACT, banana type, 4 req'd
P[illegible]		consists of: 39-10061A[illegible] CONTACT, terminal, 3 req'd
		TRANSISTOR: (SEE NOTE)
Q[illegible]10	48-[illegible]437	N-P-N, type M[illegible]437
Q[illegible]11	48-[illegible]752	P-N-P, type M[illegible]752
		RESISTOR, fixed: ±5%, 1/2 W unl stated
R[illegible]	[illegible]41	22k ±1%, 1 W
R[illegible]11	6-12[illegible]145	[illegible]k ±1%, 1/4 W
R[illegible]	6-121[illegible]	120
R[illegible]13	[illegible]-10401B34	3.3 meg, 1/4 W
R[illegible]14	17-82177B[illegible]	15, 5 W
R[illegible]15	[illegible]	[illegible] 2k
R[illegible]	17-[illegible]B2[illegible]	[illegible] 2 ±1%, 2 W
R[illegible]	[illegible]	33k
R[illegible]	6-[illegible]	470 ±1%
		VARISTOR:
RV310	[illegible]-84931E01	150 V

REFERENCE SYMBOL	MOTOROLA PART NO	DESCRIPTION

TPN6068A Power Supply PL-1949-A

		CAPACITOR, fixed: uF ±10%, 35 V unl stated
C380	23-830[illegible]G24	330 +100-10%, 250 V
C381	23-868965	12
C382	21-82187B25	.0033, 500 V
C383	23-868965	12
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR380	48-82525G14	silicon
CR381, 382	48-82525G13	silicon
CR383, 384	48-82525G15	silicon
CR385	48-82525G14	silicon
		CONNECTOR, receptacle
J380	9-84207B01	7 contact
		RELAY, magnetic reed
K380	80-84157B04	12 V dc
		COIL, choke
L380	24-82606B05	350 uH
		CONNECTOR, plug
P303		consists of: 28-84029D01 CONTACT, banana type, 5 req'd
		TRANSISTOR: (SEE NOTE)
Q380, 381	48-869702	N-P-N, type M9702
Q382	48-869700	N-P-N, type M9700
		RESISTOR, fixed, ±10%, 1/4 W unl stated
R380	6-3994	27, 2 W
R381	6-5588	39k, 1 W
R382	17-82177B02	32 ±5%, 5 W
R383	6-124B04	180k ±5%
R384	17-82177B04	5, 5 W
R385	6-127801	470
R386	6-127804	4.7k
R387	6-129234	5.6 meg
R388	17-892227	8.2 ±5%, 1/2 W
		TRANSFORMER
T380	25-84627E01	power

REFERENCE SYMBOL	MOTOROLA PART NO	DESCRIPTION

TLN4576A High End Regulator Board PL-1951-O

		CAPACITOR, fixed: uF, 25 V unl stated
C321	23-83093G18	1750 +150-10%
C322	8-82905G30	0.1 ±10%, 50 V
C323, 324	8-82905G23	.02 ±10%, 100 V
C325, 326, 327	23-83093G17	950 +150-10%, 30 V
C328	23-83214C15	4.7 ±20%
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR321	48-82256C47	Zener type
		CONNECTOR, receptacle:
J301, 302, 303		consists of: 9-84041D01 CONTACT, banana type, 14 req'd
		COIL, choke:
L321	24-82606B03	40 uH
L322	24-82606B01	120 uH
		CONNECTOR, plug
P304		consists of: 39-10061A09 CONTACT, terminal, 6 req'd
		TRANSISTOR: (SEE NOTE)
Q321	48-869570	N-P-N, type M9570
Q322	48-869571	P-N-P, type M9571
Q323	48-869640	N-P-N, type M9640
		RESISTOR, fixed; ±5%, 1/4 W unl stated
R321	6-129189	1 meg
R322	6-82810D19	3.4k ±1%, 1/2 W
R323	6-82810D11	2.94k ±1%; 1/2 W
R324	6-129299	68k
R325	6-128684	56k
R326	6-129299	68k
R327	6-128684	56k
R328	6-129189	1 meg
R329	6-6291	560 ±10%, 1/2 W
R330	6-129231	3.3k ±10%
R331	6-2032	68 ±10%, 1 W
R332	6-127804	4.7k ±10%

REFERENCE SYMBOL	MOTOROLA PART NO	DESCRIPTION

TLN4871A Strapping Board PL-1950-O

		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR350	48-82525G13	silicon
		CONNECTOR, plug:
P302		consists of: 28-84029D01 CONTACT, banana type; 3 req'd
NON REFERENCED ITEMS		
	55-84300B02	HANDLE
	42-84284B01	RETAINER, screw (black)
	54-84119B01	LABEL, warning; 2 req'd

NOTE:

For optimum performance, replacement diodes and transistors must be ordered by Motorola part number.

MECHANICAL PARTS LIST

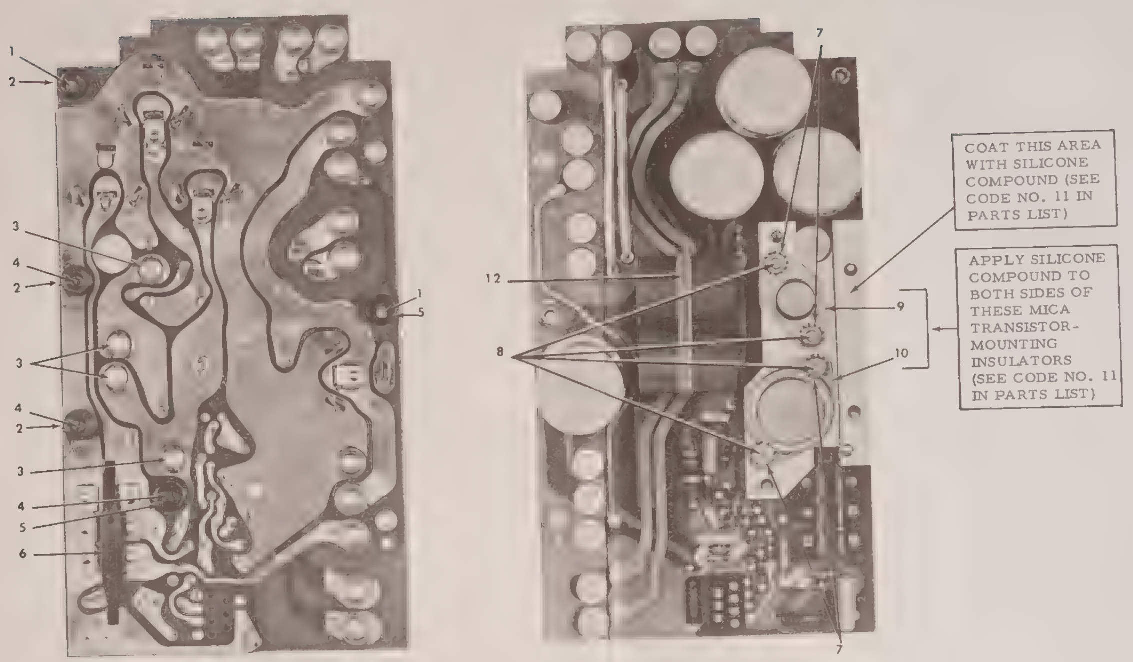
TLN4576A High End Regulator Board PL-1338-B

CODE	MOTOROLA PART NO.	DESCRIPTION
1	3-136933	SCREW, tapping: 4-40 x 3/8" Phillips round head (w/ext. lockwasher); 2 required
2	42-84284B02	RETAINER, screw: (RED); 3 required
3	3-138505	SCREW, machine: 6-32 x 9/16" slotted binder head; 4 required
4	3-138507	SCREW, tapping: 4-40 x 9/16" Phillips round head (w/ext. lockwasher); 3 required
5	42-84284B01	RETAINER, screw: (BLK); 2 required
6	55-84300B02	HANDLE, flat plastic: retractable
7	4-7666	LOCKWASHER: No. 6 external: 4 required
8	2-7005	NUT, machine: 6-32 x 1/4" hex: 4 required
9	14-83575A01	INSULATOR, transistor mounting (mica)
10	14-865854	INSULATOR, transistor mounting (mica)
11	11-834678	SILICONE COMPOUND: 1/4 oz. tube
	or 11-490487	SILICONE COMPOUND: 8 oz. tube
12	42-83553C01	STRAP, mounting

REVISIONS PEPS-9497-B

CHASSIS AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
TLN4838A	R313	FROM 6-488185, 3.3 meg; 1/2 W TO 6-10401B34, 3.3 meg, 1/4 W	PARTS LIST
TPN6068A	R380	FROM 6-488035, 47 OHMS TO 6-3994, 27 OHMS	Q382 EMITTER
TLN4838A	P301	P301-1 AND 2 WERE REVERSED	

HIGH END REGULATOR BOARD



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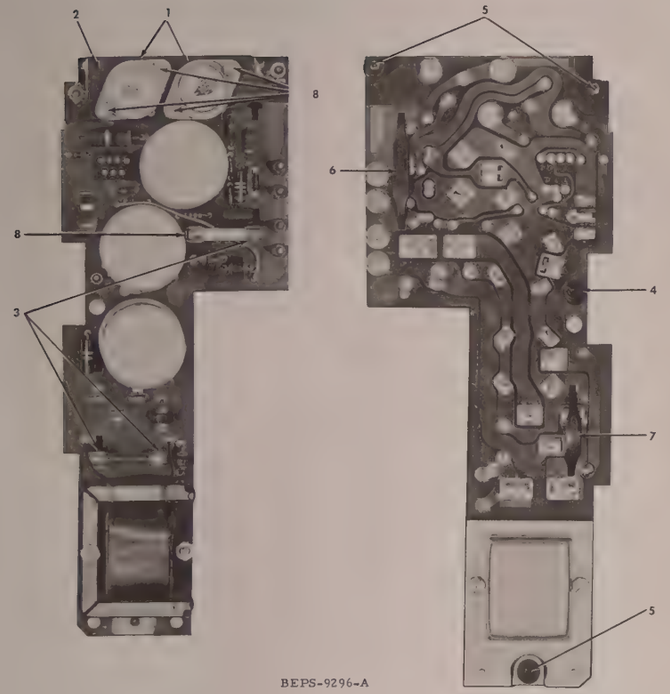
RECTIFIER FILTER BOARD



BEPS-9296-A

PARTS LIST

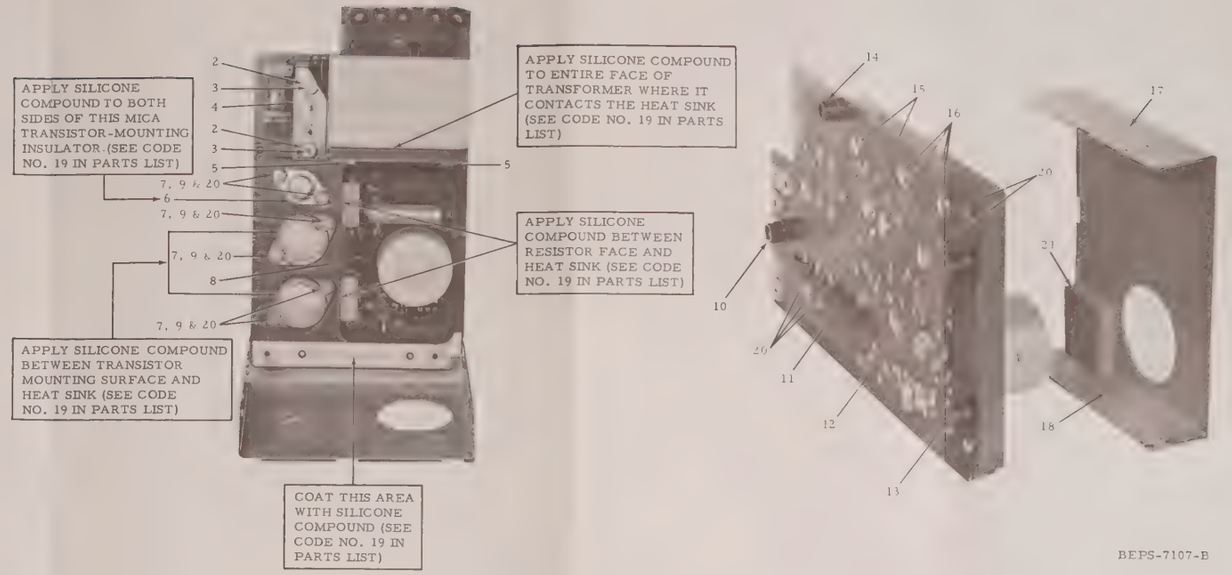
TPN6065A 72-Volt Power Supply
TPN6068A 110-Volt Power Supply PL-1336-C

CODE	MOTOROLA PART NO.	DESCRIPTION
1	64-84036D01	BRACKET, diode mounting and heat sink
2	4-10057A04	WASHER, insulating: shoulder type
3	3-134268	SCREW, tapping: 4-40 x 7/16" Phillips hex head (w/int. lock-washer); 2 required
4	14-84038D01	INSULATOR (mylar)
5	3-135664	SCREW, tapping: 6-32 x 9/16" Phillips hex head (w/ext. lock-washer); 2 required
6	14-83575A01	INSULATOR, transistor, mounting (Mica)
7	2-7005	NUT, machine: 6-32 x 1/4" hex; 6 required
8	42-84069D01	BRACKET, resistor retaining
9	4-7666	LOCKWASHER: No. 6 external; 6 required
10	3-138517	SCREW, tapping: 4-40 x 7/16" Phillips round head (w/ext. lockwasher)
11	55-84300B01	HANDLE, flat plastic: retract-able
12	3-138515	SCREW, tapping: 4-40 x 5/8" Phillips round head (w/ext. lockwasher); 3 required
13	42-84284B02	RETAINER, screw: (RED); 2 required
14	42-84284B01	RETAINER, screw: (BLK); 2 required
15	3-138505	SCREW, machine: 6-32 x 9/16" slotted binder head; 2 required
16	3-138512	SCREW, machine: 6-32 x 5/8" slotted binder head; 4 required
17	26-84067D01	SHIELD
18	14-84094D01	INSULATOR, shield
19	11-834678	SILICONE COMPOUND: 1/4 oz. tube
	or11-490487	SILICONE COMPOUND: 8 oz. tube
20	37-122979	TUBING, Teflon: No. 7 (Natural)
21	75-83778F01	PAD, hold-down

TLN4838A Rectifier Filter Board PL-1954-A

CODE	MOTOROLA PART NO.	DESCRIPTION
1	14-865854	INSULATOR, transistor; 2 req'd
2	26-84635E01	HEATSINK
3	42-82690A01	CLIP, fuse; 4 req'd
4	42-84284B01	RETAINER, screw (black)
5	42-84284B02	RETAINER, screw (scarlet); 3 req'd
6	55-84300B02	HANDLE, large
7	55-84300B03	HANDLE, small
8	42-83777F01	CLIP, fuse

110 V DC POWER CONVERTER BOARD



BEPS-7107-B

AEPS-6971-O

MODEL CHART

MODEL	CHANNELS	APPLICATION
TCN6108AJ, BJ	1-4	Non-Reverting
TCN6146A	1-8	Non-Reverting
TCN6109AJ, BJ	1-4	Automatic Channel Reverting
TCN6148A	1-8	
TCN6108AK, BK	1-4	Non-Reverting, "Private-Line" Tone-Coded Squelch
TCN6147A	1-8	
TCN6109AK, BK	1-4	Automatic Channel Reverting, "Private-Line" Tone-Coded Squelch
TCN1057AJ, BJ	1-4	Single-Tone
TCN1099A	1-8	Single-Tone
TCN1100A	1-4	Single-Tone, Reverting

MOTOROLA INC.
ENGINEERING PUBLICATIONS
1301 E. ALGONQUIN ROAD
Communications Division
SCHAUMBURG, ILLINOIS 60172

1. DESCRIPTION

The Motorola railroad control heads listed in the preceding model chart provide control facilities for AAR railroad radio sets. These control heads can be used with installations operating from a primary power source of 13.6 or 72 volts dc or 117 volts ac. Each unit includes a channel selector switch for multi-frequency operation. A five-inch speaker is mounted in the housing. An AAR microphone receptacle is provided for a telephone type handset.

The housing consists of two hinged sections of cast aluminum. The units are ruggedly constructed to withstand shock and vibration. Threaded openings (3/4" pipe thread) are provided at the top and bottom for connection of conduit.

Automatic channel reverting models return to a preselected channel when the handset is hung up.

"Private-Line" models include a "PL" ON-OFF switch. With the switch in the ON position, transmissions are coded with a "Private-Line" tone and messages are received only from other transmitters sending the same "Private-Line" tone. In the OFF position, the "Private-Line" circuits are disabled and all on-frequency transmissions can be heard.

The eight-channel model control heads provide control facilities for radio sets having more than four frequencies. This is accomplished by splitting the channels into two groups of four channels each. A toggle switch selects the desired channel group and a rotary switch selects the desired channel within the group. The automatic reverting unit will return to a preselected channel and channel group, as indicated by the indicator lights. The eight-channel models are otherwise identical to the four-channel models.

The pilot light dimmer circuit automatically controls the brillance of the blue (transmit) pilot light and the channel indicator lights mounted on the control head. In bright daylight, the lights glow brightest to insure visibility. The lights become progressively dimmer to reduce excessive glare as daylight changes to darkness. External illumination is sampled through a panel in the upper portion of the control head and acts upon a light dependent resistor which is mounted behind the panel.

The single-tone control heads incorporate two tone frequencies for signalling the "dispatcher" from the mobile unit. The unit includes a tone oscillator-amplifier, and two switches for tone selection and transmission. All other features are the same as those previously described for the four- and eight-channel control heads.

2. INSTALLATION

The control head is shipped from the factory with a cover over the top threaded opening. This cover is held in place by a tie bar, split lockwasher, and knurled nut. If the top threaded opening is used in the installation rather than the bottom opening, the cover can be removed and placed over the bottom opening.

To open the control head, loosen the screw on the left side (located midway between top and bottom) until the screw head is clear of the casting. NOTE: Complete removal of the screw is not required nor recommended.

To mount the control head, drill two holes in the housing and secure with two 1/4" diameter or larger screws. Refer to Figure 1.

a. Connections

Connect the control head to the mounting rack as shown in Figure 2. Use the furnished terminal lugs to terminate the radio set leads before connecting to the control head.

b. Reverting Channel Selection

(1) Four-Channel Models

Automatic channel reverting models are wired at the factory for channel 1 reverting. If another channel is desired for reverting, the white wire connected to terminal TB1-11 and the red-green wire connected to terminal TB2-21 should both be relocated to change the reverting channel. Make the connections as shown in the following table.

Reverting Channel	White Wire Terminal	Red-Green Wire Terminal
F1	TB1-11	TB2-21
F2	TB1-12	TB2-22 or *TB1-6
F3	TB2-13	TB2-23
F4	TB2-14	TB2-24

*In installations using control heads wired to comply with AAR specifications for terminal designations, connect the red-green wire to terminal TB1-6.

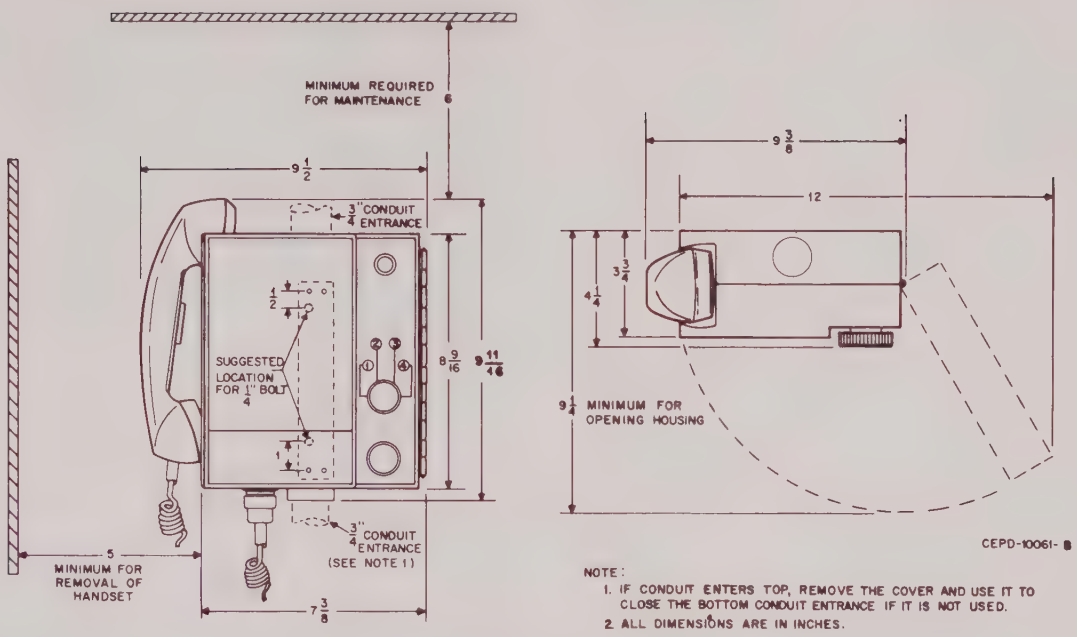


Figure 1.
Control Head Installation Detail

(2) Eight-Channel Models

Four spade-lug terminals are provided for internally selecting the channel and channel group for reverting. Make the connections as shown in the following table.

Reverting Channel	White Wire Terminal	Red-Green Wire Terminal
F1	TB1-11	TB2-21
F2	TB1-12	TB2-22 or *TB1-6
F3	TB2-13	TB2-23
F4	TB2-14	TB2-24
Reverting Group	Blue-Yellow Wire Terminal	Red-White Wire Terminal
A	TB1-3	TB2-16
B	TB1-15	TB2-19

*In installations using control heads wired to comply with AAR specifications for terminal designations, connect the red-green wire to terminal TB1-6.

c. Frequency Selector Switch

(1) Four-Channel Models

The control head is shipped from the factory with the frequency selector mechanically arranged for two-frequency operation. The control head is capable of four-frequency operation.

An adjustable switch stop is incorporated to limit the number of switch positions used in accordance with the number of operating frequencies required.

The switch stop consists of a metal washer which has a long tab for limiting knob rotation, and two small "positioning tabs" for locking the stop at any desired setting. The stop is held in place under the mounting nut and lockwasher which are used for mounting the switch.

Refer to Figure 3 and set the stop as follows:

(a) Turn the selector knob to the "F1" position.

(b) Loosen the set screw and remove the knob.

(c) Remove the mounting nut and lockwasher which hold the switch in place.

(d) Position the switch stop according to the table given below:

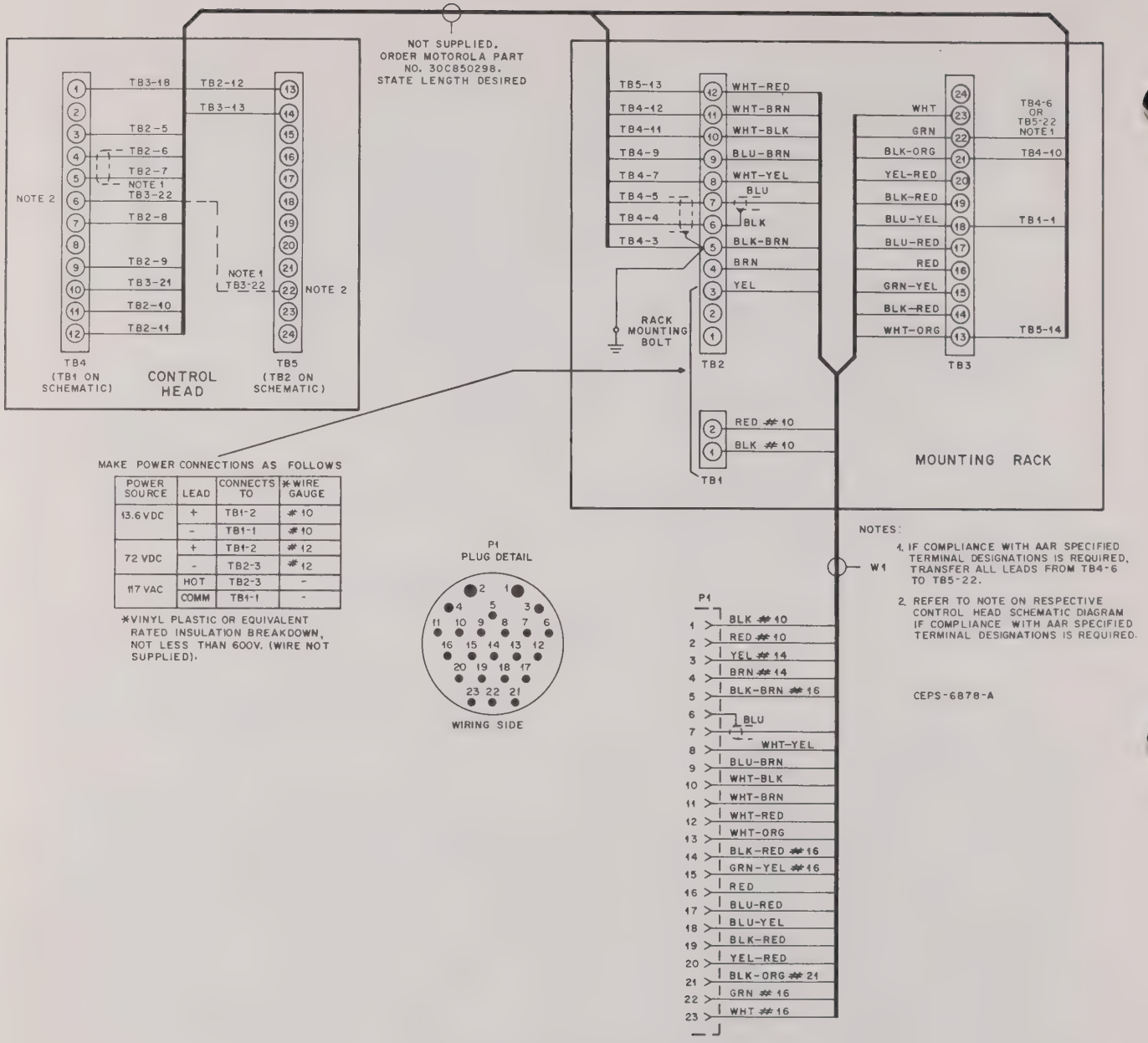


Figure 2.
Control Head Wiring

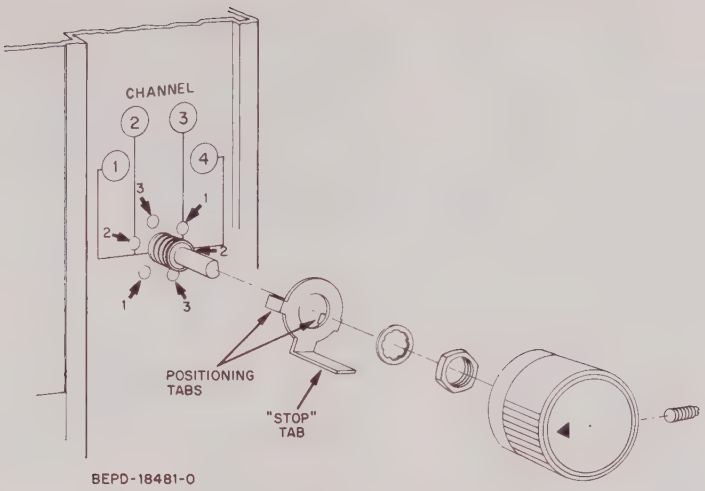


Figure 3.
Frequency Selector Switch
Mechanical Stop Detail

NO. OF FREQS	"POSITIONING TAB" SETTING	"STOP TAB" POSITION
1	1-1	*RIGHT
2	2-2	*MIDDLE
3	3-3	*LEFT
4	2-2	**MIDDLE

*Keep the tab below shaft level.
**"Park" the stop tab by positioning it directly above the shaft.

(e) Replace the lockwasher and mounting nut. Make sure that the "orientation" tab on the switch engages the hole provided in the housing, then tighten the mounting nut.

(f) Replace the knob. Position it so that the set screw will engage the flat part of the shaft.

(2) Eight-Channel Models

Set the frequency switch as previously described for the four-channel models. The adjustable stop should be positioned according to the group with the most channels. If possible arrange the channels into two equal groups.

3. AUDIO ADJUSTMENTS

The audio output level is controlled by a pad control located in the speaker input circuit. The audio output level minimum setting may be changed by replacing R2 with a resistor of a lower or higher value. This resistor is connected directly to the pad control. Increasing the resistance of R2 raises the minimum level.

The audio for the handset is taken from the input to the pad and speaker circuit. Therefore, adjustment of the speaker level pad control has no effect on the handset level.

To change the handset audio level, replace R1 (located on terminal board TB1) with a resistor of higher or lower value. Increasing the resistance will decrease the output.

4. PILOT LIGHT DIMMER

The automatic light dimmer circuit includes a voltage regulator which insures constant pilot light brillance with A+ voltages of 11.3 volts to 20.1 volts. The main components of the regulator are Q101, Q102, Q103 and Zener diode CR105. When the unregulated A+ varies, the change is felt across R106. This changes the sampling voltage at the base of Q103. If the A+ voltage decreases, Q103 conducts less and the current through Q102 and Q101 is increased. This causes the voltage drop across R106 to decrease and the voltage at Point A decreases.

5. OPERATION OF CHANNEL REVERTING

As the handset is removed from the hang-up cup, the contacts of the pushbutton switch (S2) close. The switch is located at the bottom of the top cup, out of the hang-up area. This closes the ground path for the reverting relay (K1). The control head remains on the reverting channel after the handset is removed. The operator should now choose the desired channel, and then press the red button just below the blue transmit jewel light. Notice that the frequency indicator light will always indicate the channel that the radio is receiving. Unless the red button is pushed, the knob does not necessarily indicate the correct frequency. The knob does indicate which frequency the radio set will operate on when the handset is removed and the button is pressed. The reverting channel may be selected by the service technician as explained in the INSTALLATION paragraph.

6. OSCILLATOR-AMPLIFIER (SINGLE-TONE MODELS)

The tone oscillator circuit (Q1) is basically a modified Hartley oscillator. Amplifier Q2 increases the oscillator output to level sufficient to modulate the transmitted rf signal. The tone oscillator and amplifier circuits are mounted on a printed circuit board in the control head.

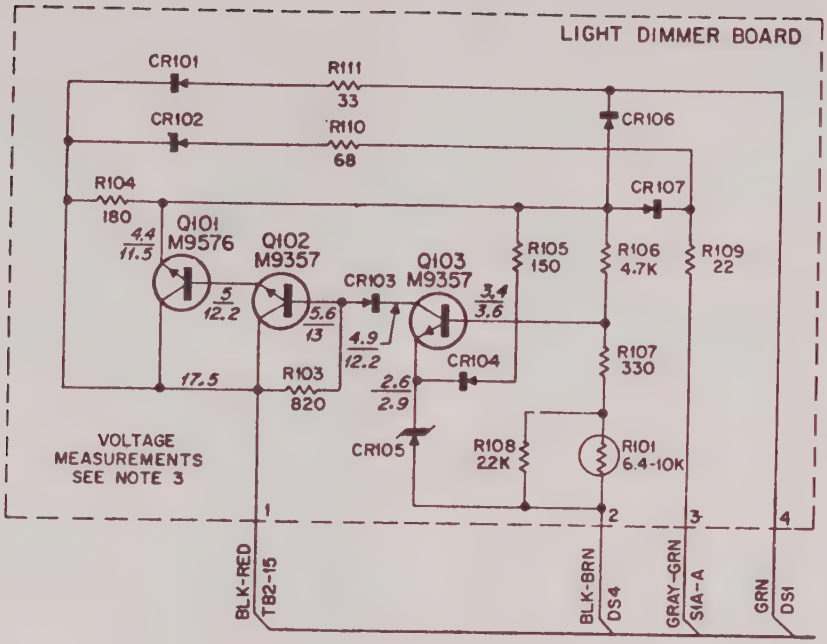
The "dispatcher" signalling operations is performed with a momentary contact, double throw toggle switch located on the front panel. Pressing the switch to the left (DISP 1) keys the transmitter and modulates the rf signal with a 2600 Hz tone. Pressing the switch to the right (DISP 2) performs the same function but modulates the rf signal with a 2200 Hz tone.

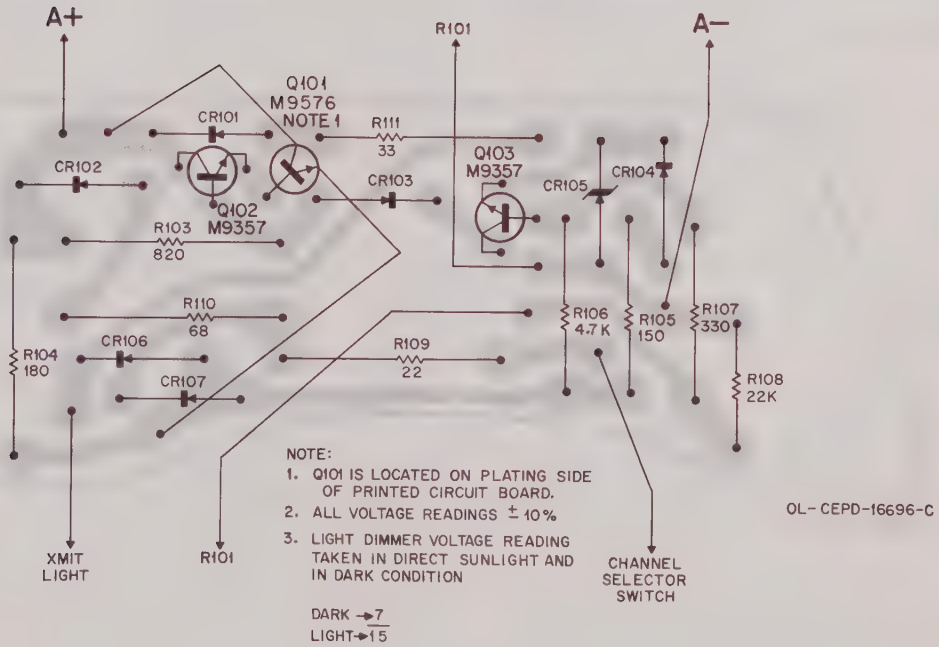
7. BULB REPLACEMENT

To replace the channel indicator lights, remove the screw in the socket mounting plate. Pull the socket mounting plate away from the castings to reveal the bulb. Insert a new bayonet type bulb and replace the socket mounting plate.

8. HANDSET

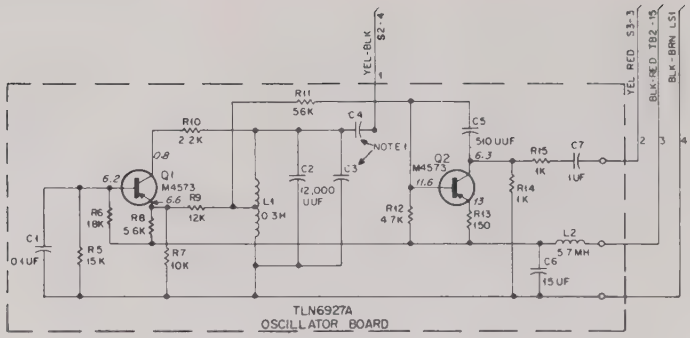
The Motorola TMN6043B and TMN6002C Handsets are available for use with this control head. They are the same except that the Model TMN6043B uses an armored cord and the Model TMN6002C uses a coiled neoprene cord. Models TMN6002A and TMN6002B can also be used and are directly interchangeable. These handsets each incorporate a transistorized preamplifier unit. The handset includes a cord, microphone connector and a cable clamp. The handset is not part of the control head but is available on separate order.

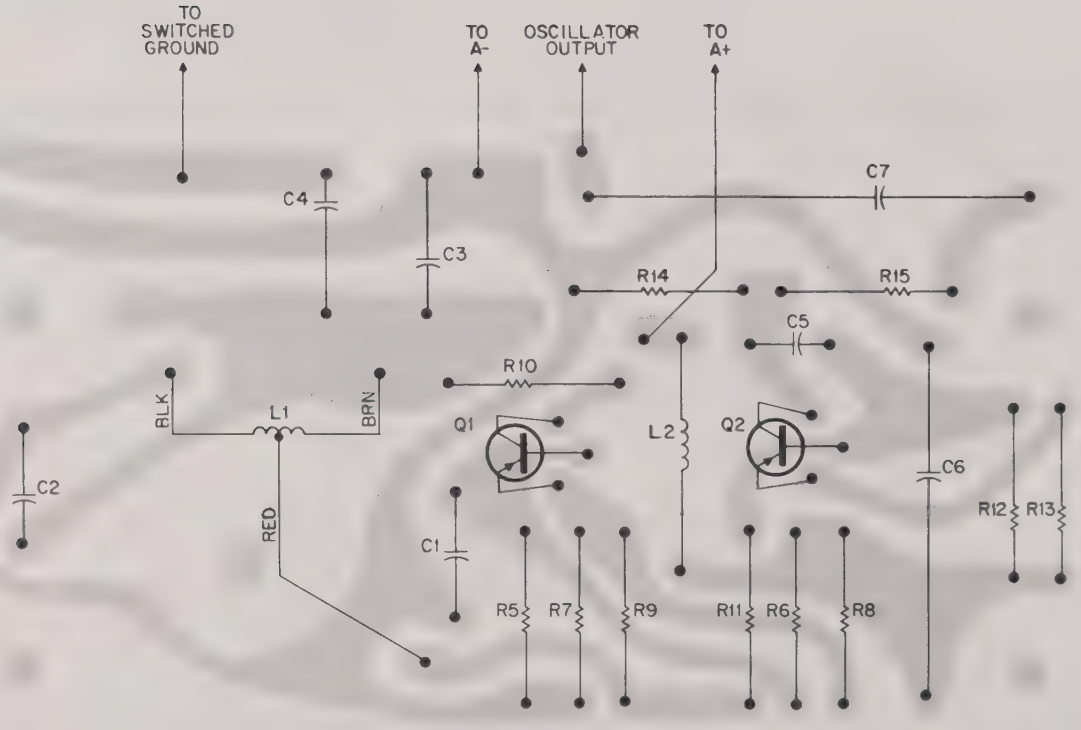




REFER TO SCHEMATIC
DIAGRAM FOR PARTS LIST

Automatic Light Dimmer
Circuit Board Detail
Motorola No. PEPD-16697-C
7/29/74-NPC



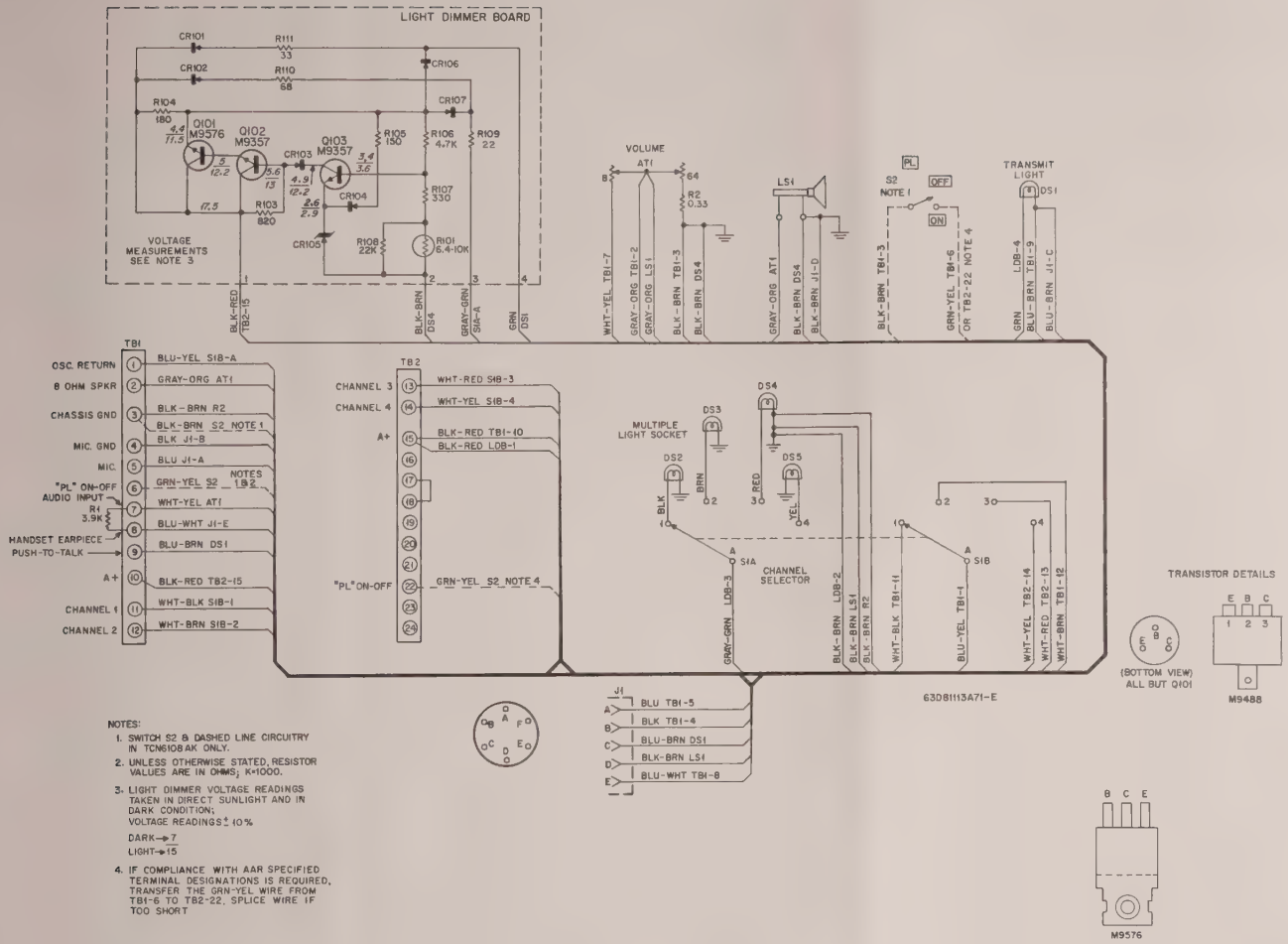


CEPD-10237-A

CONTROL HEADS

REFER TO SCHEMATIC DIAGRAM FOR PARTS LIST

Model TLN6927A Tone Oscillator
Circuit Board Detail
Motorola No. PEPD-10238-A
7/29/74-NPC



NOTES:

1. SWITCH S2 & DASHED LINE CIRCUITRY IN TCN6108AK ONLY.
2. UNLESS OTHERWISE STATED, RESISTOR VALUES ARE IN OHMS; K=1000.
3. LIGHT DIMMER VOLTAGE READINGS TAKEN IN DIRECT SUNLIGHT AND IN DARK CONDITION; VOLTAGE READINGS ± 10%
   DARK → 7
   LIGHT → 15
4. IF COMPLIANCE WITH AAR SPECIFIED TERMINAL DESIGNATIONS IS REQUIRED, TRANSFER THE GRN-YEL WIRE FROM TB1-6 TO TB2-22, SPLICE WIRE IF TOO SHORT

PARTS LIST

TCN6108AJ, BJ Control Head & Speaker, 4-freq., non-reverting, carrier squelch, w/dimmer
TCN6108AK, BK Control Head & Speaker, 4-freq., non-reverting, tone-coded squelch, w/dimmer EPD-17238-E

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		ATTENUATOR, AF: "L" pad, 12 watt:
AT1	18C82744G01	c
AT1A		8 ohms ±10%; (front)
AT1B		64 ohms ±10%; (rear)
		SEMICONDUCTOR DEVICE diode: (SEE NOTE)
CR101, 102, 106, 107	48C82466H01	silicon
CR103, 104	48C82392B03	silicon
CR105	48D82256C33	silicon; zener; 2.7 v
		LAMP, incandescent:
DS1, 2, 3, 4, 5	65R4151	6-8 v; 0.2 a; min. bay; type 51
		CONNECTOR, receptacle
J1	9C848764	female; 6 contact
		LOUSPEAKER, permanent magnet:
LS1	50D82731G01	5"; round; 8 ohm imp. 15 w; weather-resistant
		TRANSISTOR: (SEE NOTE)
Q101	48R869576	N-P-N; type M9576
Q102, 103	48R[illegible]9357	N-P-N; type M9357
		FENOL 6 [illegible]
R1	6R5018	[illegible]
R2	17K848766	[illegible]
R101	6C83828D01	light-dependent type; 6.4-10K @ 2 F.C. @ 25°C
R103	6S5701	820; 1 w
R104	17C82036G10	180; 2 w
R105	6S6373	150; 1/2 w
R106	6R3924	4.7K ±5%; 1/2 w
R107	6S6022	330; 1/2 w
R108	[illegible]	22K [illegible]
R109	6R48802[illegible]	[illegible]
R110	17C82036G01	[illegible]
R111	17C82036G11	[illegible]
		SWITCH
S1	40C82772G01	rotary; 2 pole; 4 position non-shorting
S2	40B858304	toggle dpst (Model TCN6108AK only)
		TERMINAL BOARD:
TB1, 2	31B880805	12 screw terminals
		LIGHT, indicator:
XDS1	60B82197H01	min. bay; incl BLU lens
		LAMPHOLDER ASSEMBLY:
XDS2, 3, 4, 5	9B82685G01	min. bay; 4 section
NON-REFERENCED ITEMS		
	0C82632H02	KNOB, control; 2 req'd
	28A82771G01	PLUG, threaded

NOTE:

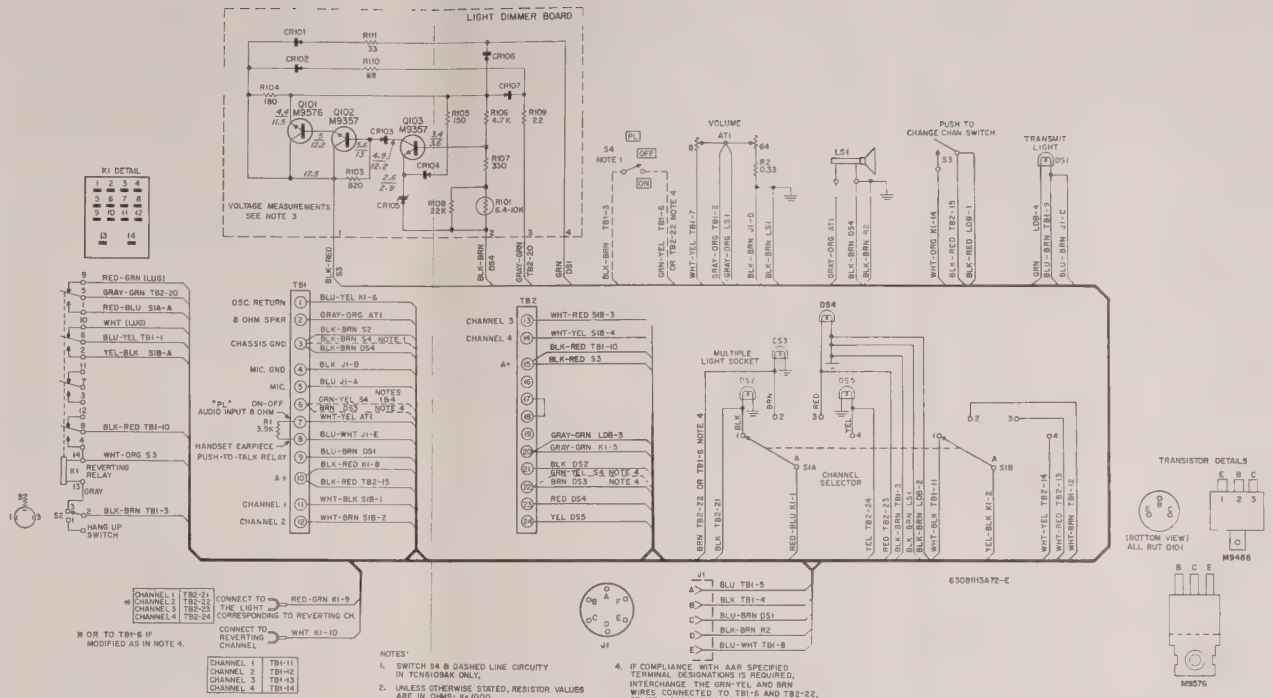
Replacement diodes and transistors must be ordered by Motorola part number only for optimum performance.

Models TCN6108AJ, BJ, and TCN6108AK, BK
Control Head Schematic Diagram
Motorola No. 63P81013E36-A
7/29/74-NPC

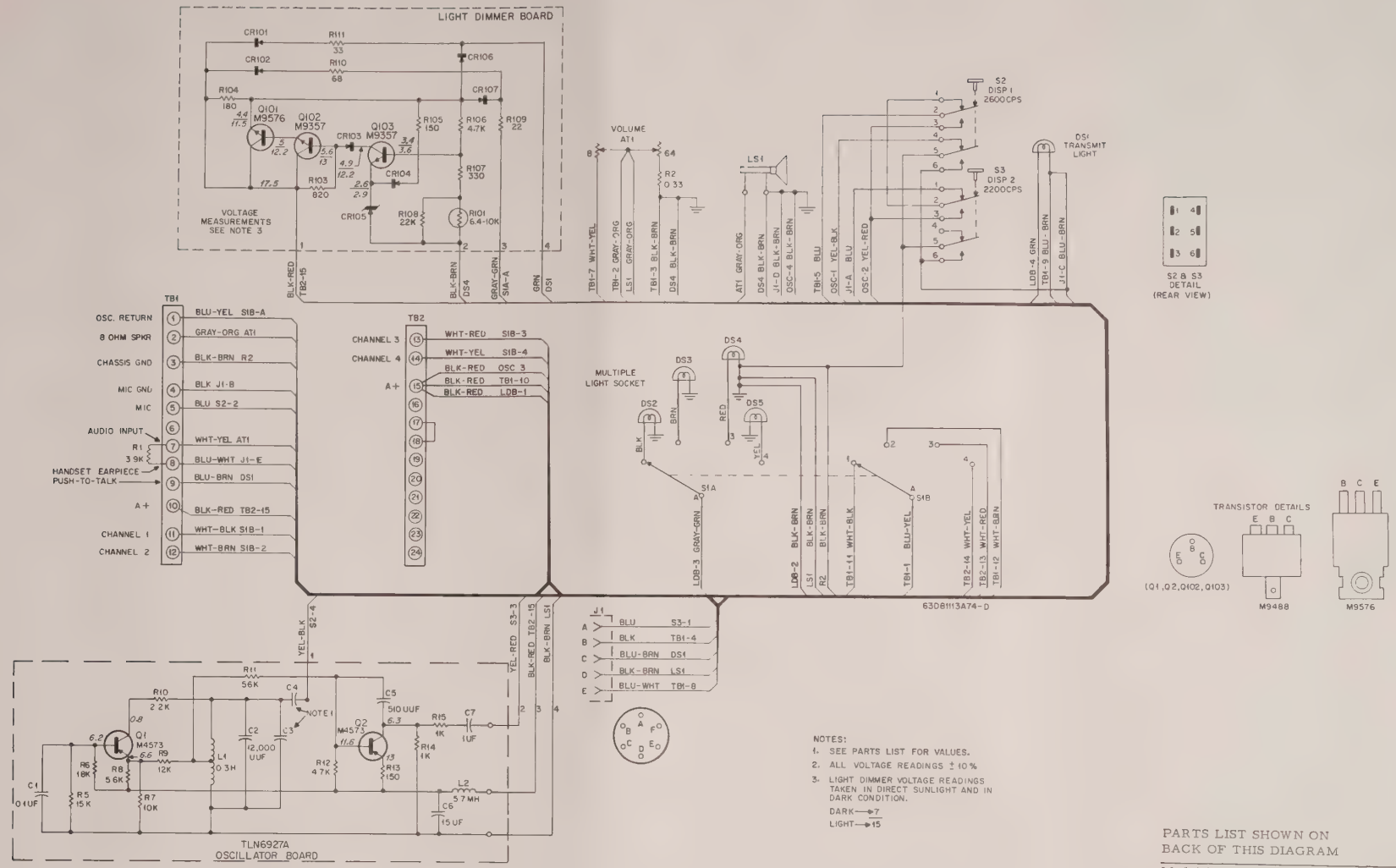
PARTS LIST

TCN6109AJ, BJ Control Head & Speaker, 4-freq., reverting, carrier squelch, w/dimmer
TCN6109AK, BK Control Head & Speaker, 4-freq., reverting, tone-coded squelch, w/dimmer EPD-17239-E

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		ATTENUATOR, AF: "L" pad: 12 watt:
AT1	18C82744G01	c/o:
AT1A		8 ohms ±10%; (front)
AT1B		64 ohms ±10%; (rear)
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR101, 102, 106, 107	48C82466H01	silicon
CR103, 104	48C82392B03	silicon
CR105	48D82256C33	silicon; zener; 2.7 v
		LAMP, incandescent:
DS1, 2, 3, 4, 5	65R4151	6-8 v; 0.2 a; min. bay; type 51
		CONNECTOR, receptacle:
J1	9C848764	female; 6 contact
		RELAY, armature:
K1	80D83576E01	4 form "C"; coil resistance: 80 ohms ±10%; @25°C
		LOUDSPEAKER, permanent, magnet:
LS1	50D82731G01	5" round; 8 ohm imp. 15 w; weather-resistant
		TRANSISTOR: (SEE NOTE)
Q101	49R869576	N-P-N; type M9576
Q102, 103	48R869357	N-P-N; type M9357
		RESISTOR, fixed: ±10%
R1	6R5618	3.9K; 1 w
R2	17K848766	0.33; 1 w
R101	6C83828D01	light-dependent type; 6.4-10K @ 2 F.C. @25°C
R103	6S5701	820; 1 w
R104	17C82036G10	180; 2 w
R105	6S6373	150; 1/2 w
R106	6R3924	4.7K ±5%; 1/2 w
R107	6S6022	330; 1/2 w
R108	6S128685	22K; 1/4 w
R109	6R488026	22; 1 w
R110	17C82036G01	68; 2 w
R111	17C82036G11	33; 2 w
		SWITCH
S1	40C82772G01	rotary; 2 pole; 4 position; non-shorting
S2	40B82737G02	push; spdt
S3	40A881084	push; spst-normally open
S4	40B858304	toggle: dpst (Model TCN6109AK only)
		TERMINAL BOARD:
TB1, 2	31B880805	15 screw terminals
		LIGHT, indicator:
XDS1	60B82197H01	min. bay; incl BLU lens
		LAMPHOLDER ASSEMBLY:
XDS2, 3, 4, 5	9B82685G01	min. bay 4 section
	NON-REFERENCED ITEM	
	36C82632H02	KNOB, control; 2 req'd



Models TCN6109AJ, BJ and TCN6109AK, BK
Control Head Schematic Diagram
Motorola No. 63P81013E37-A
7/29/74-NPC



PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

Model TCN1057AJ, BJ Control Head
Schematic Diagram
Motorola No. 63P81013E39-A
7/29/74-NPC

PARTS LIST

TCN6110AJ Control Head, with Dimmer — EPD-17236-C

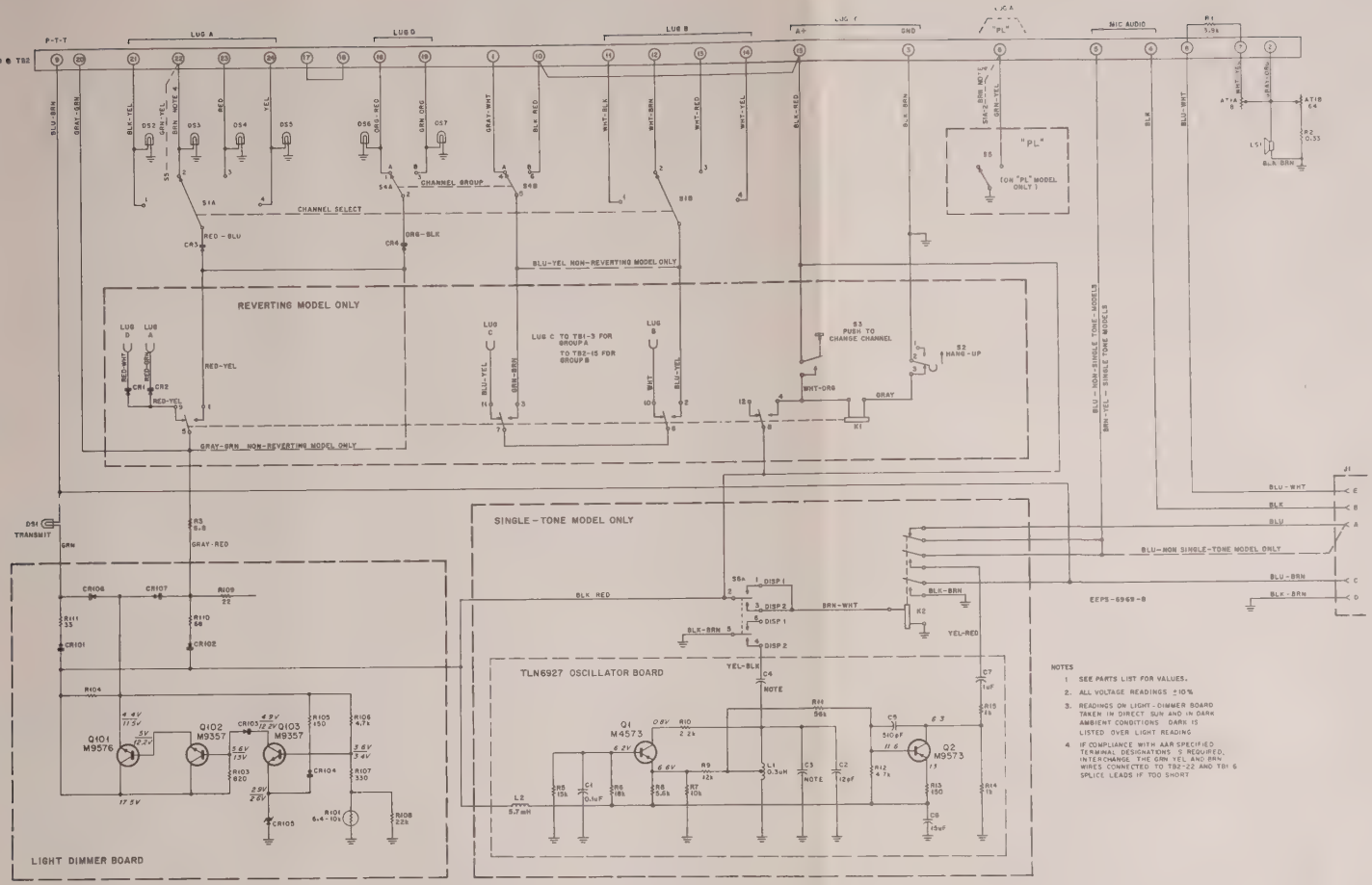
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		ATTENUATOR, AF: "L" pad; 1/2 watt:
AT1	18C82744G01	c/o:
AT1A		8 ohms ±10% (front)
AT1B		64 ohms ±10% (rear)
		SEMICONDUCTOR DEVICE diode (SEE NOTE)
CR101, 102, 106, 107	48C82466H01	silicon
CR103, 104	48C82392B03	silicon
CR105	48D82256C33	silicon; zener; 2.7 v
		LAMP, incandescent:
DS1, 2, 3, 4, 5	65R4151	6-8 v; 0.2 a; min. bay. type 51
		CONNECTOR, receptacle:
J1	9C848764	female; 6 contact
		LOUDSPEAKER, permanent magnet:
LS1	50D82731G01	5"; round; 8 ohm imp. 15 w; weather-resistant
		TRANSISTOR: (SEE NOTE)
Q101	48R869576	N-P-N; type M9576
Q102, 103	48R869357	N-P-N; type M9357
		RESISTOR: fixed: ±10%
R1	6R5618	3.9K; 1 w
R2	17K848766	0.33; 1 w
R101	6C83828D01	light-dependent type; 6.4-10K @ 2 F.C. @25°C
R103	6S5701	820; 1 w
R104	17C82036G10	180; 2 w
R105	6S6373	150; 1/2 w
R106	6R3924	4.7K ±5%; 1/2 w
R107	6S6022	330; 1/2 w
R108	6S128685	22K; 1/4 w
R109	6R488026	22; 1 w
R110	17C82036G01	68; 2 w
R111	17C82036G11	33; 2 w
		SWITCH,
S1	40C82772G01	rotary; 2 pole; 4 position non-shorting
S2, 3	40C83098A01	push; dpdt
		TERMINAL BOARD:
TB1, 2	31B880805	12 screw terminals
		LIGHT, indicator:
XDS1	60B82197H01	min. bay; incl BLU lens
		LAMPHOLDER ASSEMBLY:
XDS2, 3, 4, 5	9B82685G01	min. bay; 4 section
	NON-REFERENCED ITEMS	
	36C82632H02	KNOB, control; 2 req'd
	28A82771G01	PLUG, threaded
	3A82227A03	SCREW, special (4-40-5/16") 4 req'd

TLN6927A Oscillator Board — EPD-17237-B

REFERENCE SYMBOL	MOTOROLA PART NO	DESCRIPTION
		CAPACITOR, fixed: at ±10%; unless stated
C1	8D82905G22	.10; 100 v
C2	21K865815	12000 uuf ±1%; 500 v
C3, 4		(factory-selected; see following list)
	21D84494B24	39 uuf ±5%; 500 v
	or21D84494B31	75 uuf ±5%; 500 v
	or21D84494B07	150 uuf ±5%; 500 v
	or21D84494B14	270 uuf ±5%; 500 v
	or21K848158	390 uuf; 300 v
	or21K845214	510 uuf ±5%; 300 v
	or21K848236	650 uuf ±5%; 300 v
	or21K863298	5000 uuf ±1%; 500 v
C5	21K845214	510 uuf ±5%; 300 v
C6	23C82013C01	15-10+100%; 25 v
C7	8K863306	1; 200 v
		COIL, RF:
L1	24C813452	toroid filter; .3 uh
L2	24K864763	choke; 5.7 uh
		TRANSISTOR: (SEE NOTE)
Q1, 2	48R134573	P-N-P; type M4573
		RESISTOR, fixed: ±10%; 1/2 w unless stated
R5	6S6477	15K
R6	6S488095	18K ±5%
R7	6S5556	10K ±5%
R8	6S3940	5.6K ±5%
R9	6S6394	12K
R10	6S6069	2.2K
R11	6S6378	56K
R12	6S6080	4.7K
R13	6S6373	150
R14, 15	6S6229	1K

NOTE:

Replacement diodes and transistors must be ordered by Motorola part number only for optimum performance.



PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

Eight-Channel Control Heads
Schematic Diagram
Motorola No. 63P81013E38-B
7/29/74-NPC

PARTS LIST

IMPORTANT

USE ONLY THE FOLLOWING MOTOROLA PART NUMBERS WHEN ORDERING REPLACEMENT PARTS

8-FREQUENCY CONTROL HEADS WITH "DIMMER"

TCN6146A (Carrier Squelch)
TCN6147A ("Private-Line")
TCN6148A (Carrier Squelch with Reverting)
TCN1099A (Carrier Squelch with "Single-Tone"

PL-1317-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		ATTENUATOR, AF:
AT1	18-82744G01	"L" pad; 12-watt; consists of:
AT1A		8 ohms ±10% (front section)
AT1B		64 ohms ±10% (rear section)
		CAPACITOR, fixed: pF; ±10%; 300 V: unless otherwise stated
C1	8-82905G22	0.1 uF; 100 V
C2	21-865815	.012 uF ±10%; 500 V
C3, 4		(selected according to frequency from values listed below):
	21-863298	5000 ±1%; 500 V
	21-848158	390
	21-845214	510 ±5%
	21-848236	650 ±5%
	21-84494B24	39 ±5%; 500 V
	21-84494B31	75 ±5%; 500 V
	21-84494B07	150 ±5%; 500 V
	21-84494B14	270 ±5%; 500 V
C5	21-845214	510 ±5%
C6	23-82013C01	15 uF +100-10%; 25 V
C7	8-863306	1 uF ; 200 V
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR1 thru CR4	48-82466H12	silicon
CR101	48-82466H13	silicon
CR102	48-82466H13	silicon
CR103	48-82392B03	silicon
CR104	48-82392B03	silicon
CR105	48-82256C33	zener; 2.7 V ±5%
CR106 thru CR111	48-82466H13	silicon
		LAMP, incandescent:
DS1 thru DS7	t-4151	miniature bayonet; 6-8 V; 0.2 A; type No. 51
		CONNECTOR, receptacle:
J1	9-848764	female; 6-contact
		RELAY, armature:
K1	80-83576E01	4 form "C"; coil res 80 ohms ±10%
		SWITCH, magnetic reed:
K2	80-84157B02	2 form "A", 1 form "B"; 2 coil; resistance of each coil 285 ohms ±10%
		COIL, AF:
L1	24-813452	toroidal type; tapped: 0.3 uH
		COIL, RF:
L2	24-864763	choke; 5.7 uH
		LOUDSPEAKER, permanent magnet:
LS1	50-82731G01	5"; "pincushion" type; 15 ohms impedance; weather-resistant

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		TRANSISTOR: (SEE NOTE)
Q1	48-134573	P-N-P type M4573
Q2	48-134573	P-N-P type M4573
Q101	48-869576	N-P-N type M9576
Q102	48-869357	N-P-N type M9357
Q103	48-869357	N-P-N: type M9357
		RESISTOR, fixed: ±10%; 1/2 W: unless otherwise stated
R1	6-5618	3.9k; 1 W
R2	17-848766	0.33; 1 W
R3	6-126D65	6.8; 1 W
R4		NOT USED
R5	6-6477	15k
R6	6-488095	18k ±5%
R7	6-5556	10k ±5%
R8	6-3940	5.6k ±5%
R9	6-6394	12k
R10	6-6069	2.2k
R11	6-6378	56k
R12	6-6080	4.7k
R13	6-6373	150
R14	6-6229	1k
R15	6-6229	1k
R101	6-83828D01	photo-resistive cell: 6.4k - 10k @ 2 F.C. @ 25°C: max. allowable applied potential 60 V; max. allowable current 40 mA
R102		NOT USED
R103	6-5701	820; 1 W
R104	17-82036G10	180; 2 W
R105	6-6373	150
R106	6-3924	4.7k ±5%
R107	6-6022	330
R108	6-128685	22k; 1/4 W
R109	6-488026	22; 1 W
R110	17-82036G01	68; 2 W
R111	17-82036G11	33; 2 W
		SWITCH:
S1	40-82772G01	rotary: 2-pole; 4-position; non-shorting
S2	40-82737G02	push: spdt
S3	40-881084	push: spst
S4	40-811751	toggle: dpdt
S5	40-858304	toggle: dpst
S6	40-83568D02	toggle: dpdt; momentary; center return ("off")
		TERMINAL BOARD:
TB1	31-880805	12 dual screw terminals
TB2	31-880805	12 dual screw terminals
		LIGHT, indicator:
XDS1	60-82197H01	miniature bayonet type; includes BLU lens
		LAMPHOLDER ASSEMBLY:
XDS2 thru XDS5	9-82685G01	includes 4 miniature bayonet type lampholders
XDS6	9-84325D01	includes 2 miniature bayonet type lampholders
XDS7	9-84325D01	includes 2 miniature bayonet type lampholders

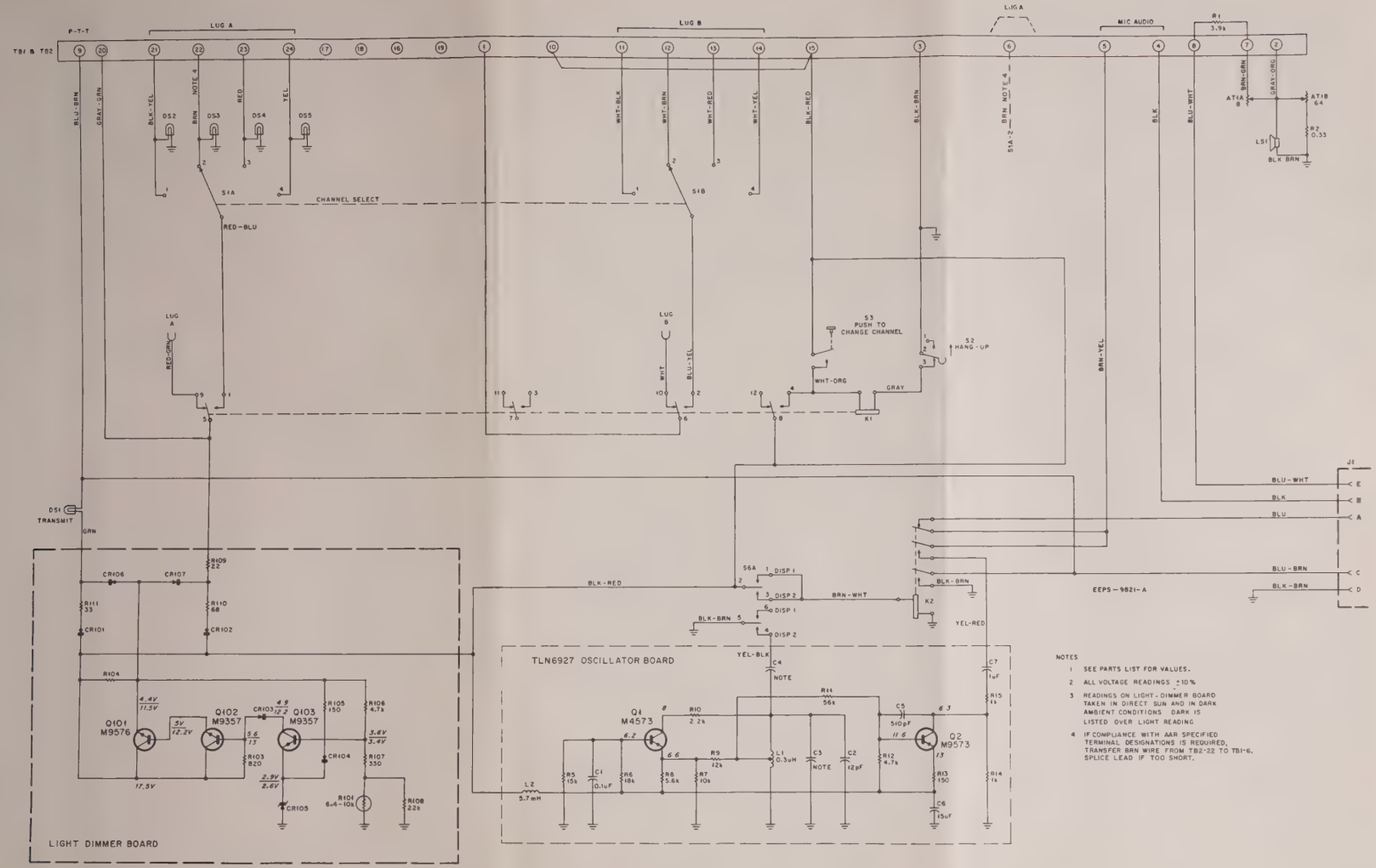
NON-REFERENCED ITEMS

	13-84298D02	ESCUTCHEON (TCN6146A)
	13-84298D05	ESCUTCHEON (TCN6147A)
	13-84298D03	ESCUTCHEON (TCN6148A)
	13-84298D01	ESCUTCHEON (TCN1099A)
	34-84300D01	DISPLAY SCREEN, channel switch position indicator
	42-861179	CLAMP, cable
	35-83628E01	CLOTH, speaker grille
	13-84301D01	GRILLE, speaker
	43-82183H01	PLUNGER, handset hang-up

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	41-82184H01	SPRING, plunger
	64-82185H01	BRACKET, plunger spring retaining
	29-3036	LUG, soldering
	26-83806D02	SHIELD, light diffusing
	28-82771G01	PLUG, threaded: special type (non-"reverting" models)
	33-82730G01	NAMEPLATE
	36-82632H02	KNOB, control
	64-83293G01	BRACKET, knob rotation limiting
	3-134184	SCREW, tapping: 4-40 x 5/16 Phillips hex head (int. lockwasher)
	3-134185	SCREW, tapping: 6-32 x 1/4 Phillips hex head (ext. lockwasher)
	3-134186	SCREW, tapping: 6-32 x 3/8 Phillips hex head (ext. lockwasher)
	3-134168	SCREW, tapping: 4-40 x 1/4" Phillips hex head (int. lockwasher)
	3-135664	SCREW, machine: 6-32 x 9/16 Phillips hex head (ext. lockwasher)
	3-136138	SCREW, machine: 6-32 x 3/8" Phillips hex head (int. lockwasher)
	3-136140	SCREW, machine: 8-32 x 5/8" Phillips hex head (ext. lockwasher)
	3-136141	SCREW, machine: 8-32 x 11/16" Phillips hex head (ext. lockwasher)
	3-129276	SCREW, machine: 10-32 x 1-1/4" Phillips oval head
	15-83290G03	HOUSING ASSEMBLY; incls:
		55-82686G01 HINGE
		15-82188H01 COVER, entrance hole
		42-82192H01 BAR, cover retainer
		4-7671 LOCKWASHER: No. 8 split
		2-800328 NUT, machine: knurled
		3-136137 SCREW, tapping: 6-32 x 5/16" slotted pan head (ext. lockwasher)
	1-80735A64	WIRE TERMINATION KIT: incls:
		29-5238 LUG, soldering: quantity of 16 supplied
		37-61348 SLEEVE, rubber: quantity of 16 supplied
	84-84321D01	DIODE BOARD, lamp isolation
	64-84355D01	BRACKET, diode board mounting
	75-82281H02	PAD, handset hang-up cushioning (top)
	75-82281H03	PAD, handset hang-up cushioning (bottom)

NOTE:

Replacement diodes and transistors must be ordered by Motorola part number only for optimum performance.



PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

Model TCN1100A
Eight-Channel Control Head
Schematic Diagram
Motorola No. 63P81017E99-A
7/29/74-NPC

PARTS LIST

TCN1100A Control Head (Single-Tone Reverting)
TCN6144A Control Head Chassis PL-1930-O

REFERENCE SYMBOL	MOTOROLA PART NO	DESCRIPTION
		ATTENUATOR, AF:
AT1	18-82744G01	"L" pad, 12-watt, consists of
AT1A		8 ohms ±10% (front section)
AT1B		64 ohms ±10% (rear section)
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR101	48-82466H13	silicon
CR102	48-82466H13	silicon
CR103	48-82392B03	silicon
CR104	48-82392B03	silicon
CR105	48-82296C33	Zener, 2.7 V ±5%
CR106, 107	48-82466H13	silicon
		LAMP, incandescent:
DS1 thru DS5	6-4151	miniature bayonet; 6-8 V, 0.2 A, type No. 51
		CONNECTOR, receptacle:
J1	9-848764	female; 6-contact
		RELAY, armature:
K1	80-83576E01	4 form "C", coil res 80 ohms ±10%
		SWITCH, magnetic reed:
K2	80-84157B02	2 form "A", 1 form "B"; 2 coil, resistance of each coil 285 ohms ±10%
		COIL, AF:
L1	24-813452	toroidal type, tapped: 0.3 uH
		COIL, RF:
L2	24-864763	choke, 5.7 uH
		LOUDSPEAKER, permanent magnet:
LS1	50-82731G01	5", "pincushion" type; 15 ohms impedance; weather-resistant
		TRANSISTOR (SEE NOTE)
Q101	48-869576	N-P-N, type M9576
Q102	48-869357	N-P-N, type M9357
Q103	48-869357	N-P-N; type M9357
		RESISTOR, fixed: ±10% 1/2 W; unless otherwise stated
R1	6-5618	3.9k; 1 W
R2	17-848766	0.33; 1 W
R103	6-5701	820, 1 W
R104	17-82036G10	180; 2 W
R105	6-6373	150
R106	6-3924	4.7k ±5%
R107	6-6022	330
R108	6-128685	22k; 1/4 W
R109	6-48026	22; 1 W
R110	17-82036G01	68; 2 W
R111	17-82036G11	33, 2 W
		SWITCH:
S1	40-82772G01	rotary; 2-pole; 4-position; non-shorting
S2	40-82737G02	push; spdt
S3	40-881084	push; spst
S6	40-81568D02	toggle; dpdt, momentary; center return ("off")
		TERMINAL BOARD:
TB1	31-880805	12 dual screw terminals
TB2	31-880805	12 dual screw terminals
		LIGHT, indicator:
XDS1	60-82197H01	miniature bayonet type; includes BLU lens
		LAMPHOLDER ASSEMBLY:
XDS2 thru XDS5	9-82685G01	includes 4 miniature bayonet type lampholders

REFERENCE SYMBOL	MOTOROLA PART NO	DESCRIPTION
		NON-REFERENCED ITEMS
	13-842480D04	ESCUTCHEON
	44-84300D01	DISPLAY SCREEN, channel switch position indicator
	42-861179	CLAMP, cable
	45-84628E01	CLOTH, speaker grille
	13-84401D01	GRILLE, speaker
	43-82434H01	PLUNGER, handset hang-up
	41-82184H01	SPRING, plunger
	64-82185H01	BRACKET, plunger spring retaining
	29-3036	LUG, soldering
	26-83806D02	SHIELD, light diffusing
	26-82771G01	PLUG, threaded; special type (non-"reverting" models)
	33-84326D01	NAMEPLATE
	30-82632H02	KNOB, control
	64-83293G01	BRACKET, knob rotation limiting
	3-134184	SCREW, tapping: 4-40x5/16" Phillips hex head (int. lock-washer)
	3-134185	SCREW, tapping: 6-32x1/4" Phillips hex head (ext. lock-washer)
	3-134186	SCREW, tapping: 6-32x5/16" Phillips hex head (ext. lock-washer)
	3-134188	SCREW, tapping: 4-40x1/4" Phillips hex head (int. lock-washer)
	3-135664	SCREW, machine: 6-32x9/16" Phillips hex head (ext. lock-washer)
	3-136138	SCREW, machine: 6-32x3/8" Phillips hex head (int. lock-washer)
	3-136140	SCREW, machine: 8-32x5/8" Phillips hex head (ext. lock-washer)
	3-136141	SCREW, machine: 8-32x11/16" Phillips hex head (ext. lock-washer)
	3-129276	SCREW, machine: 10-32 x 1-1/4" Phillips oval head
	1-80723B94	HOUSING ASSEMBLY (riveted)
	1-80735A64	WIRE TERMINATION KIT incls: 29-5238 LUG, soldering: quantity of 16 supplied 37-61348 SLEEVE, rubber: quantity of 16 supplied
	1-80724B42	DIODE BOARD, lamp isolation
	64-84355D01	BRACKET, diode board mounting
	75-82281H02	PAD, handset hang-up cushioning (top) 2 req'd.
	75-84451D01	PAD, handset hang-up cushioning (bottom)
	14B84210A01	INSULATOR, transistor: 2 req'd.
	26-84039E01	HEATSINK
	1-80769A68	LIGHT DIMMER BOARD ASSY. (includes electrical components)
	7-83597E01	BRACKET, dimmer board mtg.
	4-84152B01	WASHER, shoulder: 2 req'd.
	7-82738G01	BRACKET, relay (K1)
	1-80723B95	CABLE ASSY. (laced)

REFERENCE SYMBOL	MOTOROLA PART NO	DESCRIPTION
		TLN6927A Tone Oscillator Board FL-1931-O
		CAPACITOR, fixed: pF; ±10%, 500 V; unless otherwise stated
C1	8-82905G22	0.1 uF; 100 V
C2	21-865815	.012 uF ±10%; 500 V
C3, 4		(selected according to frequency from values listed below):
	21-863298	5000 ±1%; 500 V
	21-848158	4990
	21-845214	510 ±5%
	21-848236	150 ±5%
	21-84494B24	39 ±5%; 500 V
	21-84494B31	75 ±5%; 500 V
	21-84494B07	150 ±5%; 500 V
	21-84494B14	270 ±5%; 500 V
C5	21-845214	510 ±5%
C6	23-82013C01	15 uF +100-10%; 25 V
C7	8-863306	1 uF; 200 V
		TRANSISTOR: (SEE NOTE)
Q1	48-134573	P-N-P; type M4573
Q2	48-134573	P-N-P; type M4573
		RESISTOR, fixed: ±10%; 1/2 W; unless otherwise stated
R5	6-6477	15k
R6	6-488095	18k ±5%
R7	6-5556	10k ±5%
R8	6-3940	5.6k ±5%
R9	6-6394	12k
R10	6-6069	2.2k
R11	6-6378	8.2k
R12	6-6080	4.7k
R13	6-6373	150
R14	6-6229	1k
R15	6-6229	1k
R101	6-83828D01	photo-resistive cell; 6.4k -10k @ 2 F.C. @25°C, max. allowable applied potential 60 V; max. allowable current 40 mA

NOTE:
Replacement diodes and transistors must be ordered by Motorola part number only for optimum performance.

MOUNTING RACK
MODELS TLN1007C AND TLN1007D

These Mounting Racks serve as the mounting for the radio set and provide connection terminals for 72-volt or 13.6-volt dc power input leads as well as the 117-volt ac power leads. The rack also provides distribution of power and radio set control functions via external cables which are connected to terminal boards within the rack.

A multi-conductor cable, terminating in a 23-pin cable connector provides the necessary cabling from the terminal boards in the mounting rack to the radio set. This multi-conductor cable is supplied with the mounting rack.

Twelve leads are required to interconnect the mounting rack terminal boards (TB2 and TB3) to the associated control head. The leads (not supplied) should be routed from the mounting rack to the control head via conduit (not supplied). A 12-conductor vinyl-jacketed cable recommended for these connections is available on separate order. This inter-unit radio cable can be obtained from the Motorola Parts Department, 1313 E. Algonquin Road, Schaumburg, Ill. by ordering Motorola Part No. 30C850298. Length required must be specified.

The power cable should also be routed through conduit. The mounting rack contains one hole for 3/4" conduit and one hole for 1" conduit on each side. Plugs are supplied to cover the unused holes.

CAUTION

Polarity of the dc primary power leads must be observed when making connections to the terminal boards in the mounting rack. For 13.6-volt operation, the positive (+) lead must be connected to TB1-2 and the negative (-) lead must be connected to TB1-1. For 72-volt operation, the positive (+) lead connects to TB1-2 and the negative (-) lead connects to TB2-3.

In radios equipped for operation from the 117-volt ac source, the hot lead must be connected to TB2-3 and the common lead must be connected to TB1-1. These radios are also equipped for emergency operation from 13.6-volt dc source. The 13.6-volt dc power positive (+) lead must be connected to TB1-2 and the negative (-) lead must be connected to TB2-5.

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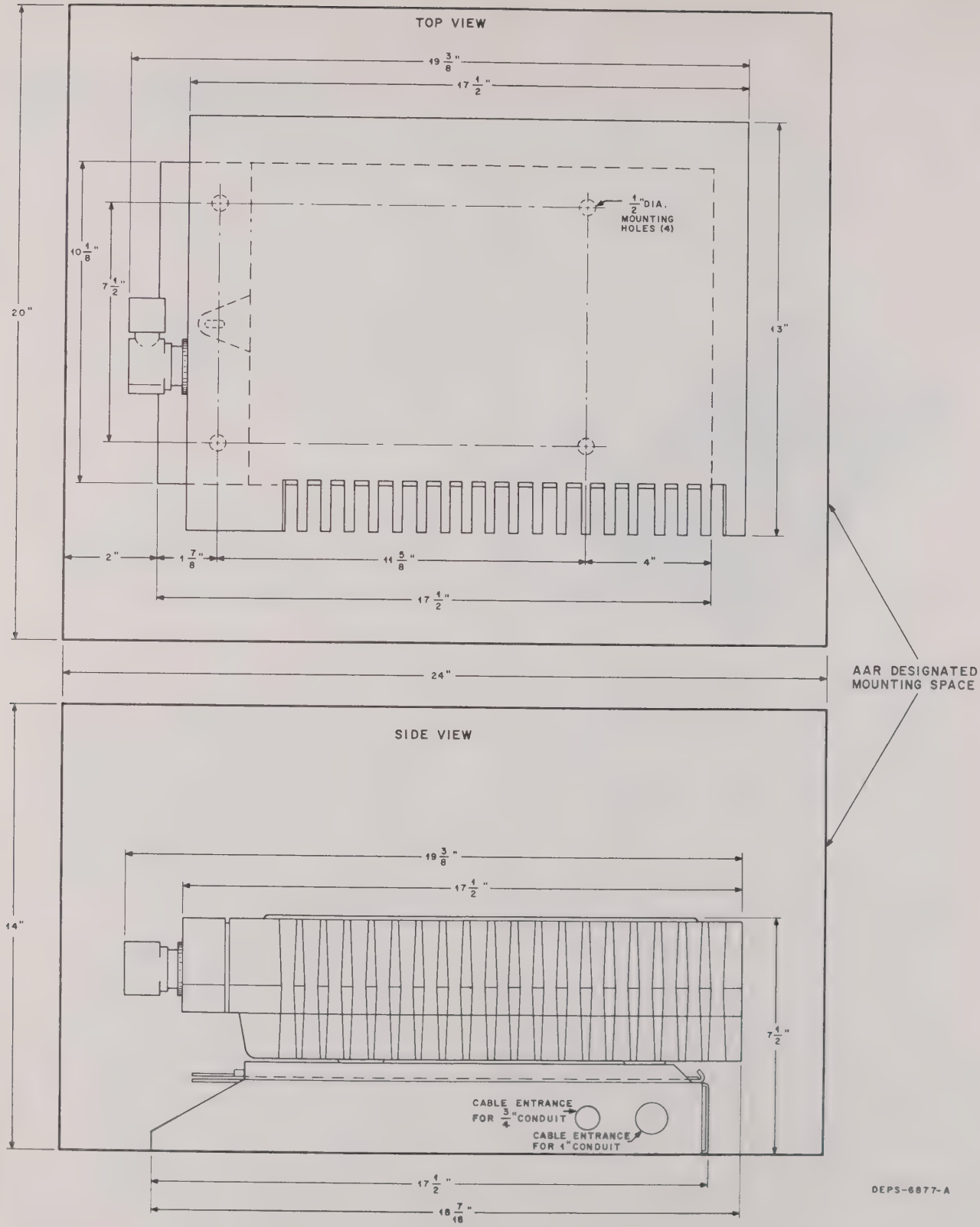
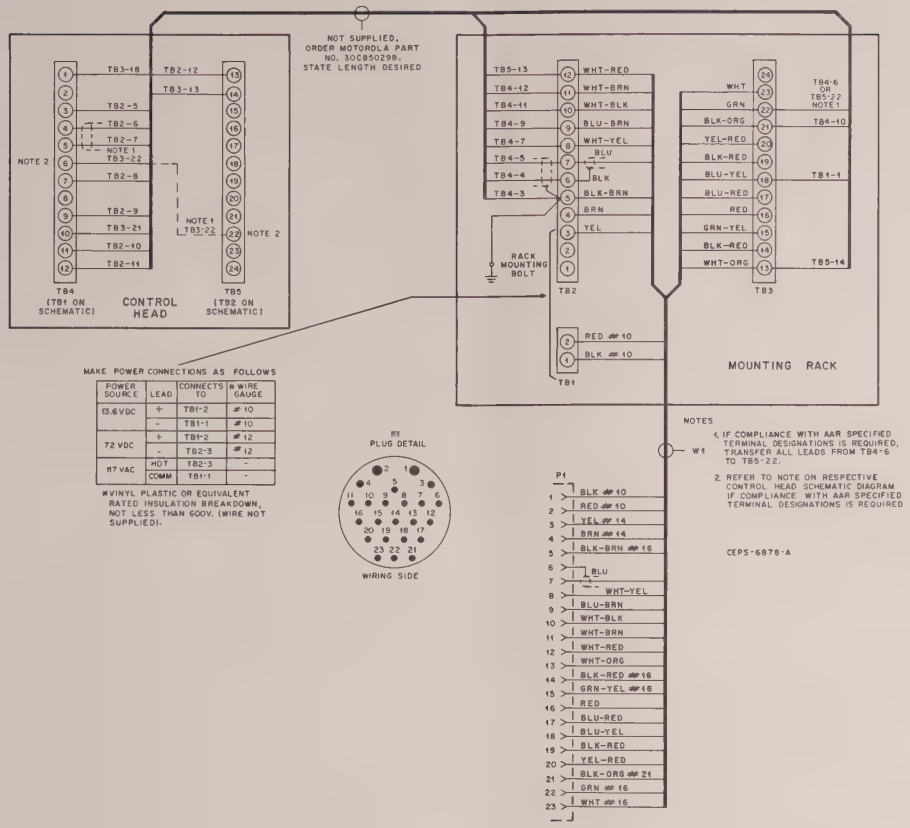


MOUNTING RACK

Installation Detail
Motorola No. DEPS-6877-A
7/29/74-NPC



REFERENCE SYMBOL	MOTOROLA PART NO	DESCRIPTION

PARTS LIST

TLN1007C and TLN1007D Mounting Rack PL-1309-A

P1	9-948776	CONNECTOR, plug: female; 23 cont.
TB	31-848767	BOARD, term: 2 screw term.
TB2, 3	[illegible]-50355	12 screw term.
W	1-848810	CABLE ASSY, special purpose: incl: ref. part P1 & the following items: 30C848744 CABLE, 22 conductor; 29" length req'd 42B850816 CLAMP, cable: 29K848901 LUG, term: #8 stud, coded RED, 19 req'd 29K848902 LUG, term: #8 stud coded BLU, 1 req'd 29K848903 LUG, term: #10 stud coded YEL, 2 req'd
NON-REFERENCED ITEMS		
	7-82469C11	RACK, mounting: BLK (TLN1007D)
	7D82469C08	RACK, mounting: BLU (TLN1007C)
	13-848775	MARKER, term. board: (1-12,
	13-813242	MARKER, term. board: (13-24)
	13-82470C01	MARKER, term board: (1-2)
	42-82471C01	CLAMP, cable
	38-848944	BUTTON, plug: for 1-3/8" hole 2 req'd
	38-863351	BUTTON, plug: for 1-3/32" hole 2 req'd
	1-80714A90	CLEVIS ASSY. incl 72A851005 BRACKET, clevis; 3A82472C01 BOLT, clevis, 2A851001 NUT, [illegible]A50115 BUSHING, [illegible] ROLLPIN

Intercabling Diagram
Motorola No. 63P81013E33-B
7/29/74-NPC

MOTOROLA
DYNAMIC HANDSETS

MODEL TABLE

MODEL	DESCRIPTION
TMN6002D	Dynamic Handset with Coiled Cord
TMN6043B	Dynamic Handset with Armored Cable
TMN6082A	Dynamic Handset with Coiled Cord
TMN6083A	Dynamic Handset with Armored Cable

1. APPLICATION

1.1 These telephone type dynamic handsets are primarily for use in railroad radio installations. They are terminated in an AAR specified type connector (AN3102-14S-6S) for plug-in to the associated radio set control unit. The handsets are available in models with a conventional neoprene coiled cord, or with an armored cable.

1.2 The TMN6082A and TMN6083A Models a are electrically equivalent to the TMN6002D and TMN6043B Models respectively, however, they are physically different in length and width. The TMN6082A and TMN6083A Models are not mechanically compatible with the TLN6489A or TLN6490A Hang-Up Cups.

2. DESCRIPTION

The handsets include a dynamic microphone cartridge with a built-in transistorized preamplifier stage, a conventional magnetic receiver cartridge, and a push-to-talk switch. The microphone requires operating power only when the push-to-talk switch is depressed. Otherwise, it does not load the power source. The microphone output impedance is 500-ohms at 1000 Hz. Its frequency response is essentially flat between 300 and 3000 Hz. The microphone will perform satisfactorily over an ambient temperature range of -30°C to +65°C. The receiver cartridge input impedance is 125-ohms ±10% at 1000 Hz.

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68P81105E36
Issue - A

MOTOROLA
DYNAMIC HANDSET

MODEL TABLE

MODEL	DESCRIPTION
TMN6002C	Dynamic Handset
TMN6043A	Dynamic Handset with armored cord

The TMN6002C and TMN6043A Dynamic Handsets are primarily for use in railroad radio installations. They are exactly the same, except that the TMN6043A uses an armored cord and the TMN6002C uses a standard neoprene coiled cord. The connector is an AAR specified type (AN3102-14S-6S). A built-in transistorized pre-amplifier with a low output impedance (500-ohms at 1000 Hz) is contained in the microphone cartridge. Frequency response is essentially flat between 300 and 3000 Hz. The microphone will operate satisfactory over an ambient temperature range of -30°C to +65°C. The earphone impedance is 125-ohms ±10% at 1000 Hz.

The dynamic cartridge requires input power only when the push-to-talk switch is pressed. It does not load the associated power source otherwise. Contacts on the switch connect the cartridge into the switch when the bar is pressed. The switch mounting plate is chrome plated and "Nylock" mounting screws are used.

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68P81106A41
Issue - D

PARTS LIST

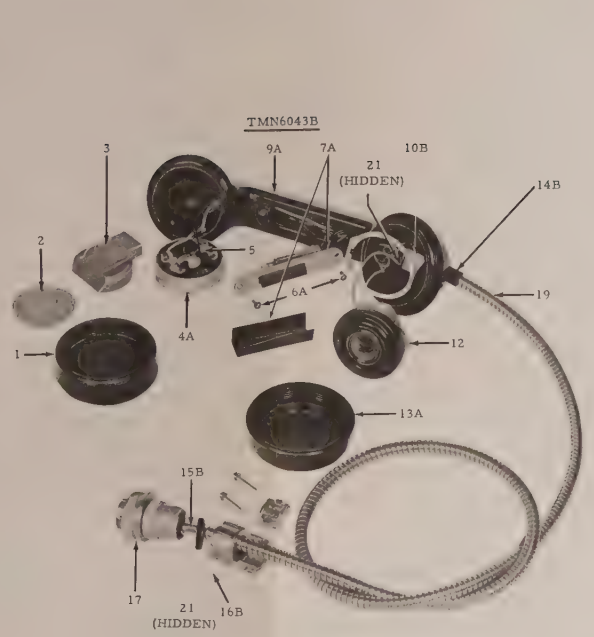
IMPORTANT

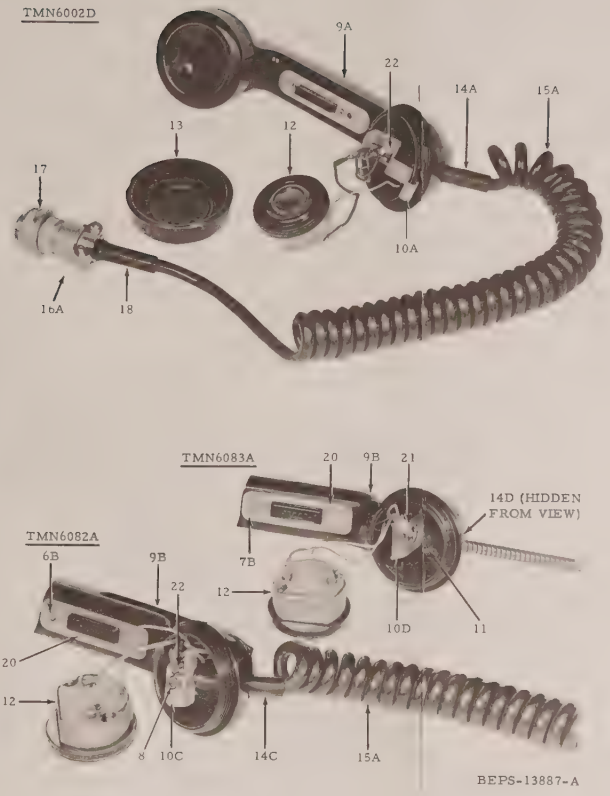
USE ONLY THE FOLLOWING MOTOROLA PART NUMBERS WHEN ORDERING REPLACEMENT PARTS

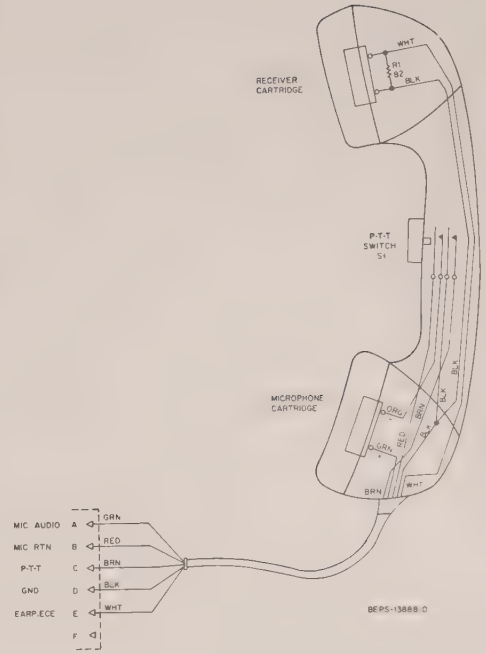
TMN6002D/TMN6043B/TMN6082A/ TMN6083A Handsets

PL-2735-A

CODE NUMBER	MOTOROLA PART NO.	DESCRIPTION
1	15-83982F02	CAP, receiver (TMN6002D & TMN6043B)
	15-83982F01	CAP, receiver (TMN6082A & TMN6083A)
2	14-84318F01	INSULATOR, weight
3	46-83974F01	WEIGHT, handset
4A	59-84398F01	CARTRIDGE, receiver (TMN6002D & TMN6043B)
4B	59-84058A01	CARTRIDGE, receiver (TMN6082A & TMN6083A)
5	6-129224	RESISTOR, fixed: 82 ±10%; 1/4 W
6A	3-82416G01	SCREW, self locking: 2 req'd. (TMN6002D & TMN6043B)
6B	3-124432	SCREW, machine: 4-40 x 1/4 ; 2 req'd. (TMN6082A & TMN6083A)
7A	40-82085L01	SWITCH,push-to-talk w/insulator (TMN6002D & TMN6043B)
7B	40-83985F01	SWITCH, push-to-talk (TMN6082A & TMN6083A)
8	3-2950	SCREW, machine:4-40x1/4" (TMN6002D, TMN6082A)
9A	15-84604F01	HOUSING (TMN6002D & TMN6043B) and transmitter cap
9B	15-84605F01	HOUSING (TMN6082A & TMN6083A) and transmitter cap
10A	42-83979F01	RETAINER, coil cord (TMN6002D)
10B	42-83976F01	RETAINER, armor cable (TMN6043B)
10C	42-83980F01	RETAINER, coil cord (TMN6082A)
10D	7-84427G01	BRACKET, armored cable (TMN6083A)
11	32-82942B03	GASKET, "O" ring (TMN6083A)
12	59-82933C01 or 59-82933C02	CARTRIDGE, transmitter
13		CAP, transmitter (TMN6002D & TMN6043B, P/O 15-84604F01 HOUSING)
	15-84055A01	CAP, transmitter(TMN6082A & TMN6083A)
14A	37-83981F01	SLEEVE, strain relief (TMN6002D)
14B	37-10719A01	TUBING, heat shrink (TMN6043B)
14C	37-84826G02	SLEEVE, strain relief (TMN6082A)
14D	37-134371	TUBING, heat shrink (TMN6083A)
15A	30-82565B33	CORD, coiled (TMN6002D & TMN6082A, P/O 1-80757B71 HANDSET CORD)
15B	30-864145	CORD, 5 conductor (TMN6043B & TMN6083A)
16A	42B84825G01	CLAMP, cable (TMN6002D & TMN6082A)
16B	42-851544	CLAMP, cable (TMN6043B & TMN6083A)
17	28-848760	CONNECTOR, plug, 6 contacts
18	37-84826G01	SLEEVE, strain relief (TMN6002D & TMN6082A)
19	30-83847E01	CABLE, armored (TMN6043B & TMN6083A)
20	15-84053A01	COVER, switch (TMN6082A & TMN6083A)
21	42-10217A02	STRAP, CABLE HARNESS (6043B, 6083A)
22	42-82782A01	CLAMP GRND PLTO (6002D, 6082A)

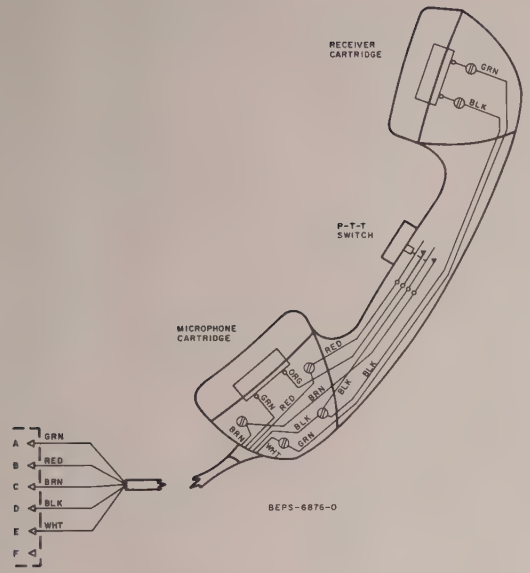






DYNAMIC HANDSET

Dynamic Handsets
Schematic Diagram and Parts Location
Motorola No. [illegible]
12/15/75-NPC

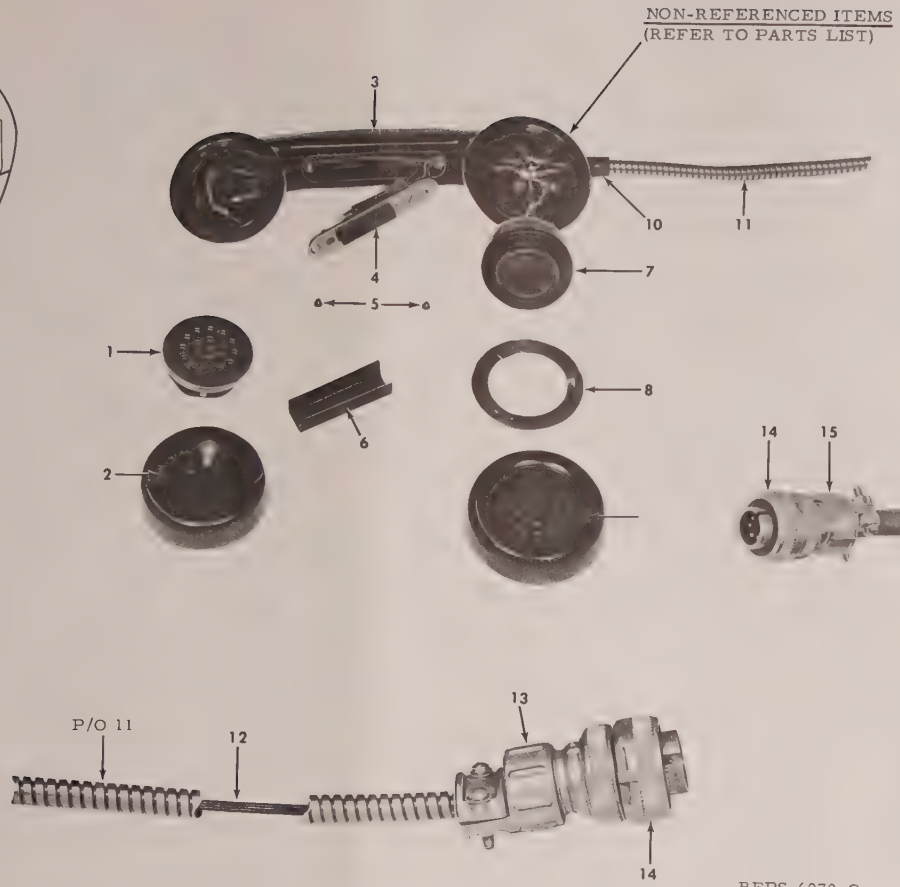


NOTE

HANDSETS SHIPPED PRIOR TO APRIL, 1970 UTILIZE THE 50-82994G01 HANDSET ASSEMBLY AND CAN BE READILY IDENTIFIED BY THE PRESENCE OF FOUR HOLES IN THE RECEIVER EARPIECE, WHILE THOSE SHIPPED AFTER APRIL, 1970 UTILIZE THE 50-83307F01 HANDSET ASSEMBLY WHICH HAS SIX HOLES IN THE RECEIVER EARPIECE. THE NON-INTERCHANGEABLE ITEMS ARE LISTED BELOW.

OLD VERSION (BEFORE 4/70)	NEW VERSION (AFTER 4/70)
50-82994G01 MICROPHONE (COMPLETE)	50-83307F01
59-850852 CARTRIDGE, RECEIVER	59-83308F01
55-850854 HANDLE	55-83308F02
15-850855 CAP, RECEIVER	15-83308F03

EPS-11811-O



PARTS LIST

IMPORTANT

USE ONLY THE FOLLOWING MOTOROLA PART NUMBERS WHEN ORDERING REPLACEMENT PARTS

TMN6002C Handset (coiled cord)
TMN6043A Handset (armored cord) PL-1306-B

CODE NUMBER	MOTOROLA PART NO.	DESCRIPTION
1	59-83308F01	RECEIVER ELEMENT ("cartridge")
2	15-83308F03	CAP, receiver
3	55-[illegible]02	HANDLE
4	40-83165A01	SWITCH, "push-to-talk"; incls mounting plate
5	3-82416C01	SCREW, switch-mounting; [illegible]
6	14-83164A02	INSULATOR, switch
7	59-82933C01	MICROPHONE ELEMENT
	or59-82933C02	("transmitter cartridge") incls solid-state amplifier
8	42-82112E01	RETAINER, microphone element
9	15-868297	CAP, "transmitter"; incls set screw
10	11-2506	TUBING, insulating; No. 9 BLK; 1" length req'd
11	30-83847E01	CONDUIT ASSEMBLY, metal, flexible (cord armor) (TMN6043A)
12	30-864145	CORD, handset; straight; 5-conductor (TMN6043A)
13	42-851544	CLAMP, cable (TMN6043A); used with item 14
14	28-848760	CONNECTOR, plug; male; 5-contact
15	42-848761	CLAMP, cable (TMN6002C); incls item 16; used with item 14
16	[illegible]	BUSHING, cord strain relief
17	30-854038	CORD, handset; coiled 5-conductor (TMN6002C)
18	37-842245	BUSHING, cord strain relief
NON-REFERENCED ITEMS		
	4-7667	LOCKWASHER: No. 4 external type
	42-[illegible]2A1	CLAMP, cord grip (TMN6002[illegible])
	[illegible]	LUG, soldering; ring tongue (TMN6002C)
	42-82742B03	GASKET, cushioning ("O" ring) (TMN6043A)
	42-83663G01	RETAINER, conduit (TMN[illegible]43A)
	42-10217A02	STRAP, cable harness (cord retainer) (TMN6043A)
	29-5293	LUG, soldering; internal locking type (TMN6043A)
	32-84622A01	GASKET, transmitter cap

NOTES:

I. Reference items 2 thru 6 can be obtained as a unit. Order [illegible] 7F01 HANDSET.

II. Reference items 14 thru 17 can be obtained as a unit. Order [illegible] 80734A22 COILED CORD & PLUG ASSEMBLY.

DYNAMIC HANDSET

Handset
Schematic Diagram and Parts Location
Motorola No. 63P81013E31-B
7/29/74-NPC

TIME-OUT TIMER

MODEL TLN1361A

AEPS-6405-O

TECHNICAL CHARACTERISTICS

TIME-OUT PERIOD	approximately 1 minute
TIMER INPUT	keyed +9.1 to +10.1 volts dc @1.25 mA (timing) @17 mA (timed out)
TIMER OUTPUTS	switched ground for modulator clamping, 2 volts @10 mA
	approximately 1000 Hz alert tone @10 millivolts rms (level adjustable)
POWER REQUIREMENTS	continuous +9.1 to +10.1 volt dc @3.5 mA

1. DESCRIPTION

The time-out timer is an optional accessory plug-in module that automatically disables the transmitter after one minute of continuous keying and applies an alert tone to the speaker of the radio. The alert tone notifies the operator that the transmitter is "off-the-air" and that he should release

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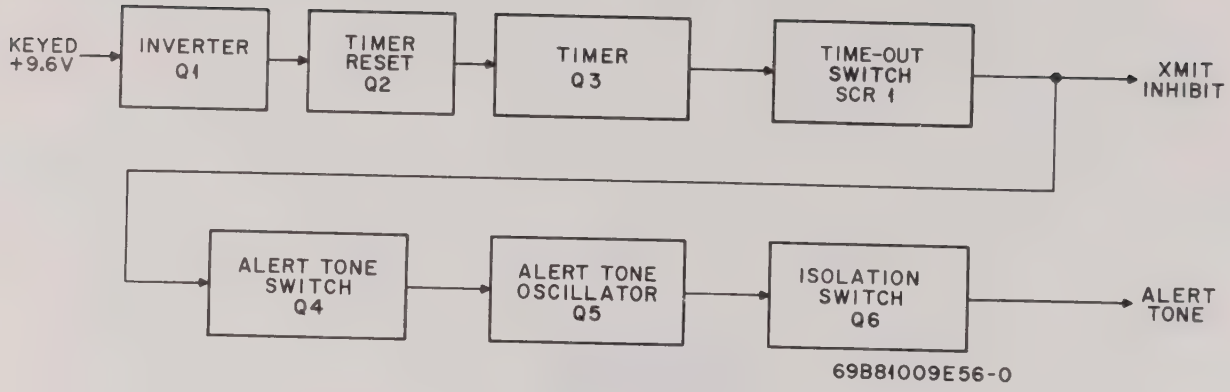


Figure 1.
Time-Out Timer Block Diagram

the push-to-talk switch. As soon as the push-to-talk switch is released, the timer resets. The level of the alert tone is not affected by the volume control setting.

The unit is a small plug-in module, fully enclosed in a protective metal housing. Contacts on the base of the module mate with five pins on the control board of "Micor" radio sets. The module may be added to radios at any time by simply plugging it in and adding the retaining spring. No other modifications are required.

2. OPERATION

a. Timing and Switching Circuit

Refer to Figure 2. When the transmitter is keyed, forward bias is applied to the base of the N-P-N inverter transistor Q1 and turns it on. The collector voltage of Q1 decreases and the N-P-N timer reset transistor turns off. This allows C1 to begin charging through R5, increasing the anode voltage of the programmable unijunction transistor Q3.

A programmable unijunction transistor is a diode (see Figure 3.) that will not conduct in the forward direction until the voltage on the anode exceeds the voltage applied to the gate by 0.6 volt. When that point is reached, the programmable unijunction transistor conducts until capacitor C1, is completely discharged. It takes about one minute for the charge on C1 to exceed by 0.6 V the gate voltage determined by the divider resistors R6 and R7.

The conduction of Q3 fires the time-out switch SCR1 causing it to conduct and ground the transmitter modulator through CR1. The time-out switch will continue to conduct as long as the keyed 9.6 volts is present.

b. Alert Tone Circuit

Refer to Figure 4. When SCR1 conducts, forward bias is applied to the base of the P-N-P alert tone switch transistor Q4, turning it on. The unijunction alert tone oscillator Q5 produces a tone whose frequency is determined by R12 and C5.

The unijunction transistor Q5 has three leads; emitter, base 1 and base 2. When C5 charges to approximately 60% of the voltage from base 2 to base 1, the emitter begins to conduct, and capacitor C5 is discharged across R14. When the capacitor is discharged, current flow stops and charging begins again through R12. Thus a pulse appears across R14 at a 1kHz rate.

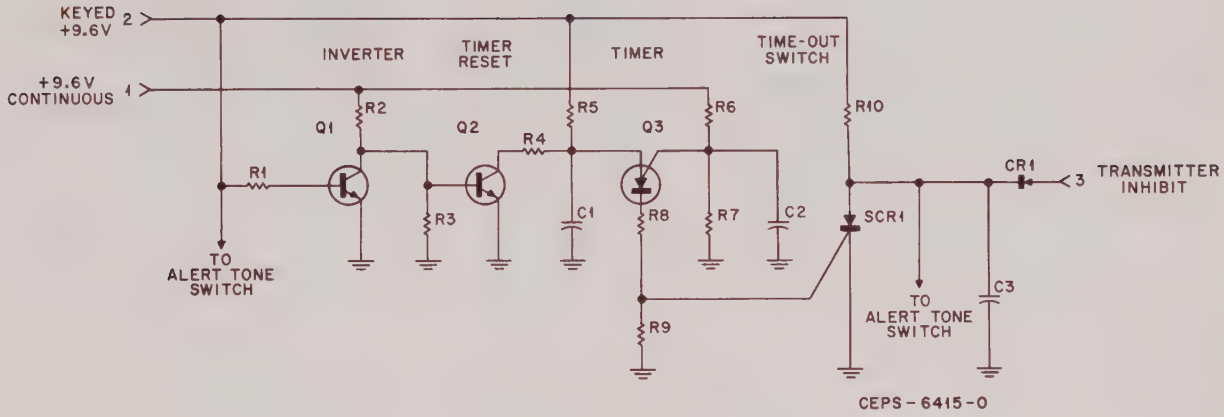


Figure 2.

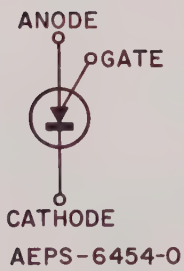


Figure 3.
Programmable
Unijunction Transistor

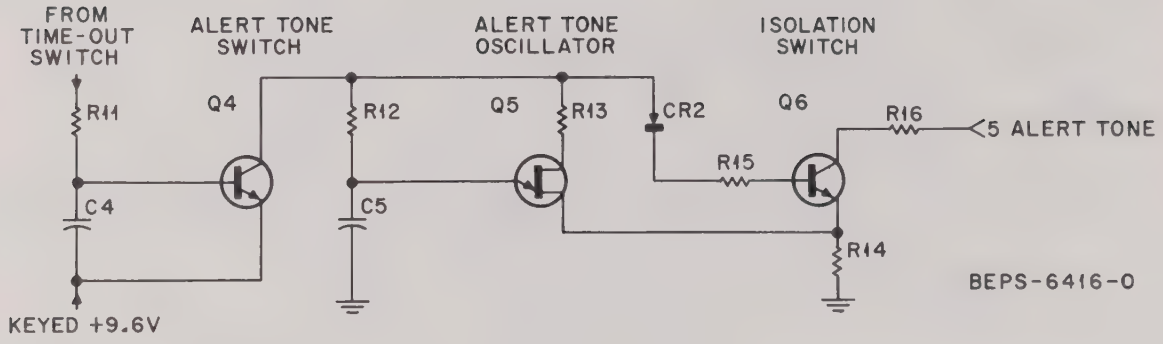


Figure 4.
Alert Tone Circuit

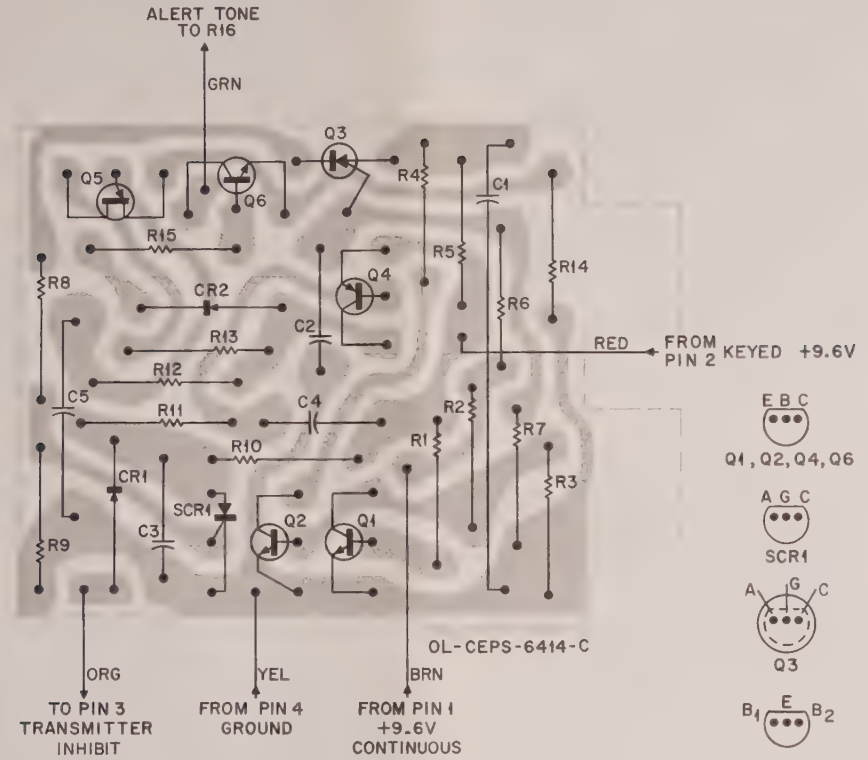
The N-P-N isolation switch Q6 turns on passing the alert tone to the audio/squelch board. When the alert oscillator is not in operation, Q6 presents an open circuit to the audio circuit.

The time-out timer resets itself whenever the transmitter is unkeyed. If the time-out switch has not been turned on when the transmitter is unkeyed the charge accummulated on C1 is discharged through R4 and Q2 to ground. If the alert tone is already on, it is shut off as soon as the transmitter is unkeyed, because the keyed 9.6 v which supplies power to the switches, oscillator, and the time-out switch is removed. Any charge on C1 will be discharged by the timer reset and ensure the full time interval on the next transmission.

3. MAINTENANCE

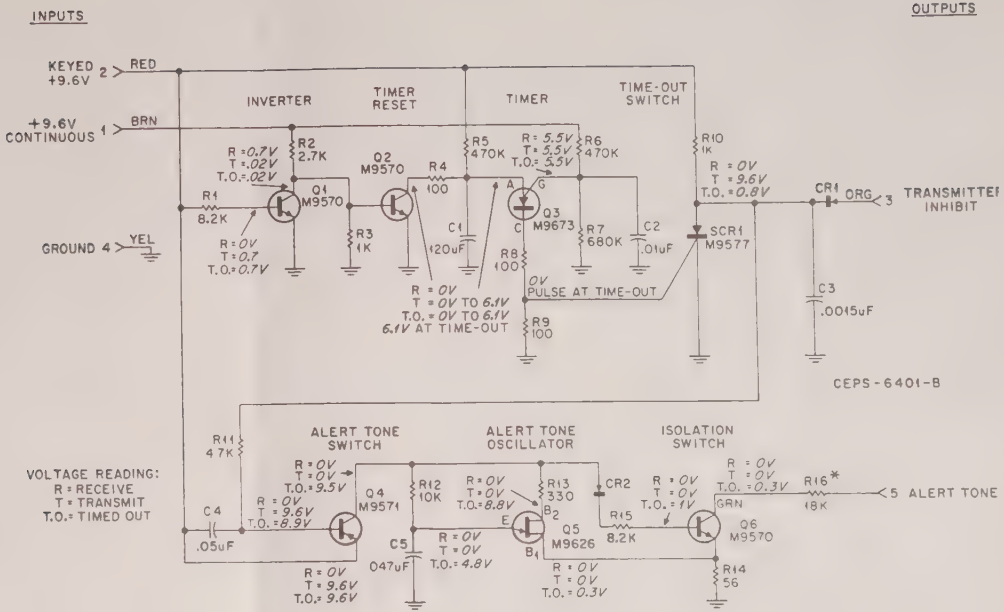
If the alert tone is not heard, determine whether the transmitter turns off as required. If it does, check Q4, Q5, and Q6. If it doesn't, check Q1, Q2, Q3, and SCR1. The module can be removed so that these checks can be made by unfastening the retaining clip and pulling the unit straight out from the printed circuit board. Remove the screws from the side of the unit and slide off the shield to expose the circuit components. Using a dc voltmeter and a +9.6 volt dc voltage source, measure the transistor element voltages. In this way the faulty stage may be found.

TIME-OUT TIMER



INPUTS

OUTPUTS

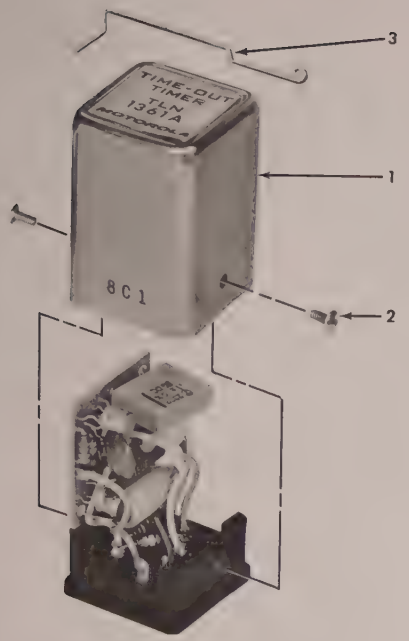


REVISIONS 63P81008E78-D

CHASSIS AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION

PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

Time-Out Timer
Schematic Diagram and
Circuit Board Detail
Motorola No. 63P81008E78-D
7/29/74-NPC



AEPS-6406-A

MECHANICAL PARTS LIST

IMPORTANT

USE ONLY THE FOLLOWING MOTOROLA PART NUMBERS WHEN ORDERING REPLACEMENT PARTS

PL-1000-B

CODE	MOTOROLA PART NO.	DESCRIPTION
1	26B82136H05	SHIELD, cover: does not include: 75A82200H01 PAD, foam rubber 37S10127A02 TUBING, insulating: 1.3" diameter; 1-1/4" length req'd 33A83224D02 NAMEPLATE
2	3S2902	SCREW, machine: 2-56 x 3/16" slotted binder head: 2 req'd
3	41A84297B01	SPRING, retaining

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

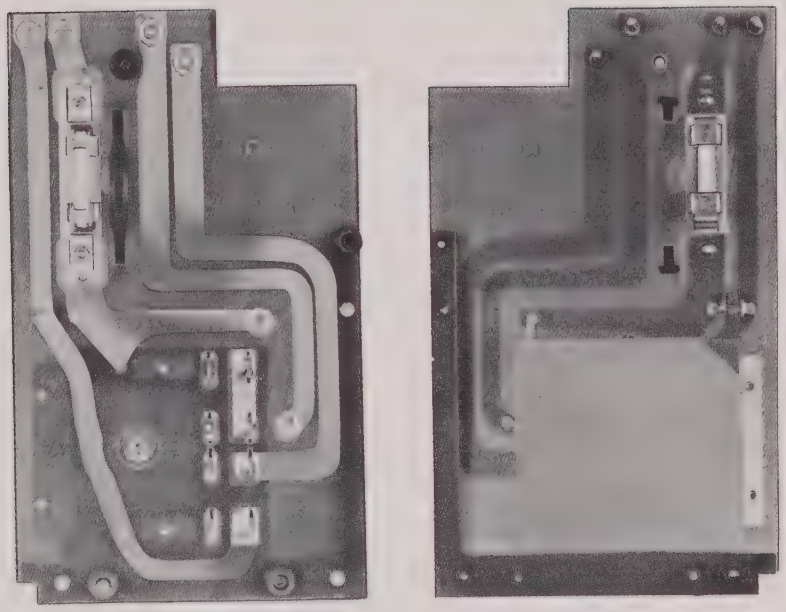
TIME-OUT TIMER

TLN1361A Time-Out Timer PL-999-F

		CAPACITOR, fixed: uF; ±10%; unless otherwise stated
C1	23D83185D01	120; 15 V
C2	21D82428B59	.01 +80-20%; 200 V
C3	21D82187B31	.0015; 100 V
C4	21C82372C07	.05 +80-20%; 25 V
C5	8D82905G03	.047;50 V
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR1	48C83654H01	silicon
CR2	48C83654H01	silicon
		CONNECTOR, receptacle:
J1	1V80763A66	female; 5-contact (mounting base)
J911	39S10184A24	Push pin; female
		TRANSISTOR: (SEE NOTE)
Q1	48R869570	N-P-N; type M9570
Q2	48R869570	N-P-N; type M9570
Q3	48R869673	programmable unijunction; type M9673
Q4	48R869571	P-N-P; type M9571
Q5	48R869626	P-N unijunction; type M9626
Q6	48R869570	N-P-N; type M9570
		RESISTOR, fixed: ±10%; 1/4 W; unless otherwise stated
R1	6S128686	8.2K
R2	6S185B84	2.7K; 1/8 W
R3	6S127802	1K
R4	6S129753	100
R5	6S185B14	470K ±5%; 1/8 W
R6	6S129149	470K ±5%
R7	6S131857	680K ±5%
R8, 9	6S129753	100
R10	6S127802	1K
R11	6S127804	4.7K
R12	6S185B95	22K; 1/8 W
R13	6S129775	330
R14	6S10401C19	5o
R15	6S128686	8.2K
R16	6S129232	3.9[illegible]
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
SCR1	48R869577	silicon; controlled; type M9577

13.6 V DIRECT BOARD

MODEL TLN4575A



BEPS-6985-O

1. DESCRIPTION

This board may be used in place of the 13.6 V dc power converter board, but only if the 13.6 volt input is well regulated and free of transients. It permits the 13.6 volt input to be applied directly to the radio without transient suppression and without dc-to-dc conversion. This module consists of a power-type relay mounted on a printed circuit board of the same shape and having the same pin configurations as the 13.6 V dc power converter board. In operation, the relay is energized when voltage is present on the 13.6 V dc input lines (P302-4, -5). This causes the positive input voltage to be connected to the A+ bus of the radio set, and the negative input voltage line to be connected to chassis ground.

NOTE

This module cannot be used in positive-ground installations. A diode (shunting the relay winding) provides reverse-polarity protection. In case of accidental incorrect input voltage polarity, the 20A fuse will blow.

The relay remains unenergized when the radio set is connected in the 72-volt configuration, and

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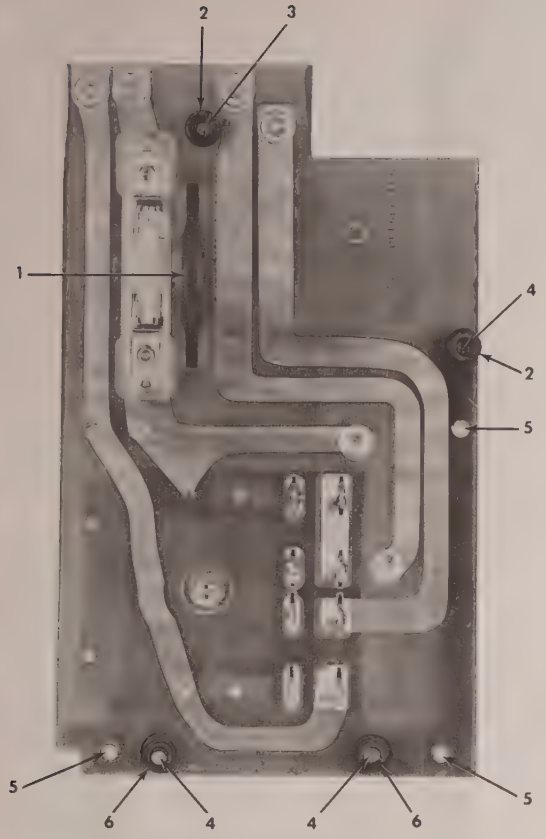
hence isolates the A+ bus from any high-voltage transients which may appear across the +13.6/72 V line to ground.

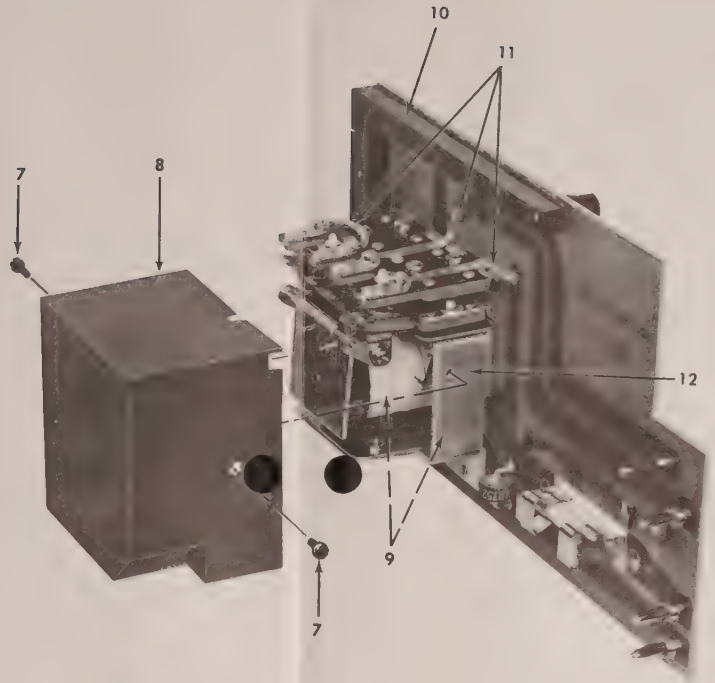
2. MAINTENANCE

When voltage is applied to the radio set, a "click" will be heard when the relay energizes. If the relay fails to energize, the voltage at the output of this board (P302-1, -2) will measure zero. Check:

a. The fuse. If bad, the voltage polarity on the input lines may be reversed.

b. The relay winding for an open circuit. The relay winding resistance should measure approximately 50 ohms or 10 ohms, depending upon the polarity of the ohmmeter leads.





BEPS-7109-O

PARTS LIST

TLN4579A 13.6 V DC Direct Board PL-1342-O

CODE	MOTOROLA PART NO.	DESCRIPTION
1	55-84300B02	HANDLE, flat plastic: retractable
2	42-84284B01	RETAINER, screw: (BLK); 2 required
3	3-138517	SCREW, tapping: 4-40 x 7/16" Phillips round head (w/ext. lockwasher)
4	3-138515	SCREW, tapping: 4-40 x 5/8" Phillips round head (w/ext. lockwasher); 3 required
5	3-135996	SCREW, drive: No. 4 x 3/16" plain round head; 3 required
6	42-84284B02	RETAINER, screw: (RED); 2 required
7	3-82126B06	SCREW, machine: (nylon); 4-40 x 1/4" slotted round head; 2 required
8	15-84095D01	COVER, relay
9	3-132963	SCREW, machine: 8-32 x 1/4" Phillips round head; 2 required
10	43-84118D01	SPACER, board-mounting: plastic; BLK; "L"-shaped
11	37-127829	TUBING, insulating: "Teflon"; No. 16; clear (specify length when ordering)
12	7-84097D01	BRACKET, relay-mounting

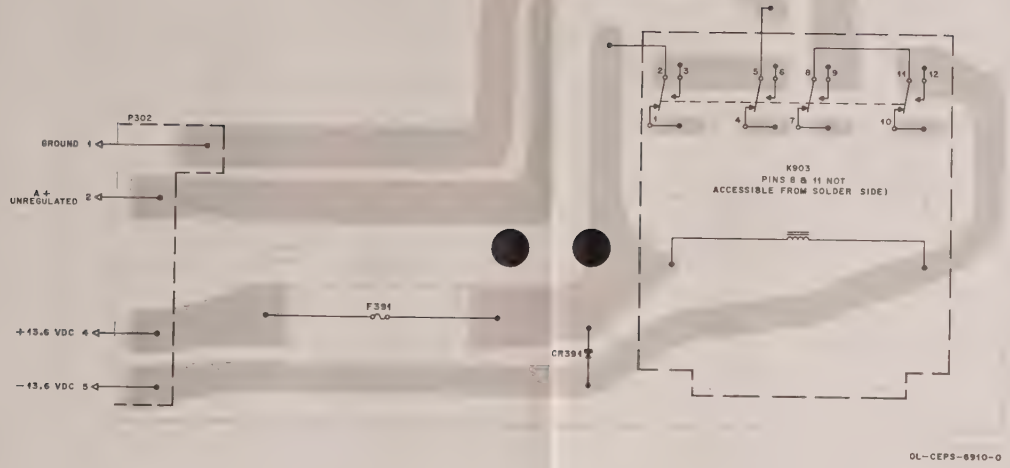
ELECTRICAL PARTS LIST

TLN4575A 13.6 V DC Direct Board PL-1344-O

REFERENCE SYMBOL	MOTOROLA PART NO	DESCRIPTION
CR391	48D82525G13	SEMICONDUCTOR DEVICE diode (SEE NOTE) [illegible]
F391	65S13[illegible]G13	FUSE, cartridge [illegible] 4 [illegible] 4 [illegible] A 250 V
[illegible]	[illegible]	RELAY, armature 4 form "C"; coil res 51 ohms ±10% does not include cover (see mechanical parts list)
[illegible]		CONNECTOR, plug consists of male contact terminals mounted on circuit board ("banana" type, Part No. 28B84029D01)

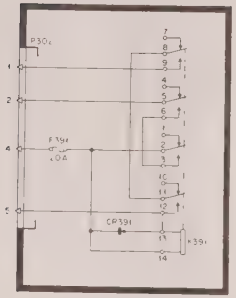
NOTE

Replacement diodes must be ordered by Motorola part number only for optimum performance.



OL-CEPS-6910-O

13.6V DIRECT BOARD

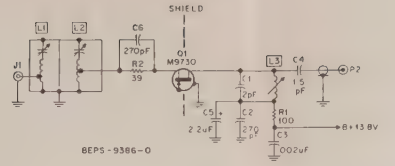


BEPS-6796-O

PARTS LIST SHOWN ON
BACK OF THIS DIAGRAM

13.6 V DC Direct Board
Schematic and Circuit Board Detail
Motorola No. 63P81013E64-O
7/29/74-NPC

13.6 V DIRECT BOARD



TRANSISTOR Q1 IS MOUNTED THROUGH THE BOARD, AND ITS CASE IS COMMON TO GROUND PLATING ON BOTH SIDES

PARTS LIST SHOWN ON
BACK OF THIS DIAGRAM

Receiver RF Preamplifier For 150.8-174 MHz
Railroad "Micor" Radio Set
Schematic Diagram & Circuit Board Detail
Motorola No. PEPS-9383-O
7/29/74-NPC

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

ELECTRICAL PARTS LIST

IMPORTANT

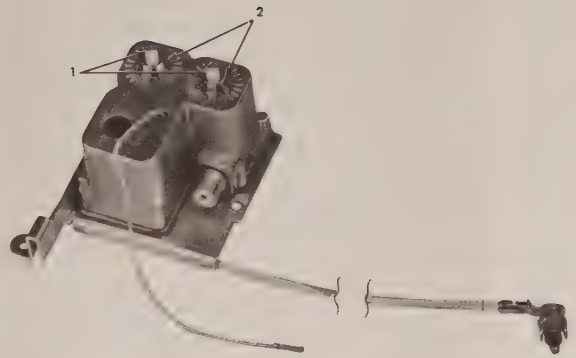
USE ONLY THE FOLLOWING MOTOROLA PART NUMBERS WHEN ORDERING REPLACEMENT PARTS

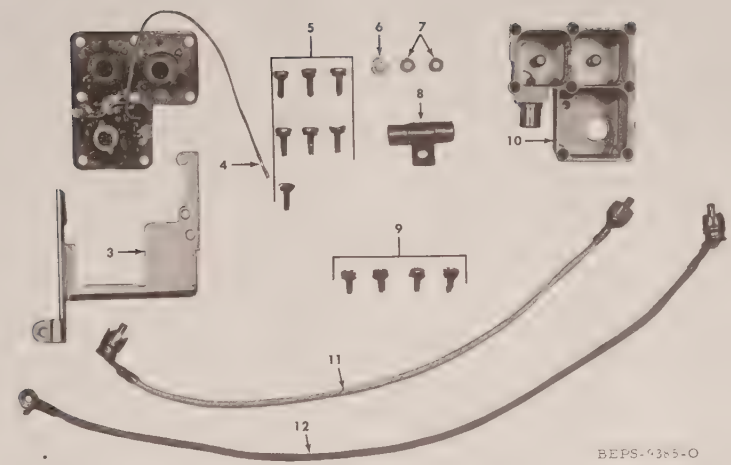
TLD8752A RF Preamplifier — PL-1850-O

		CAPACITOR, fixed:
C1	21-83406D52	2.0 pF ±0.25 pF; 500 V
C2	21-82187B04	270 pF ±10%; 500 V
C3	21-83596E14	.002 uF ±20%; 200 V
C4	21-868487	1.5 pF ±.25%; 500 V
C5	23-84762H04	2.2 uF ±20%; 25 V
C6	21-82187B04	270 pF ±10%; 500 V
		CONNECTOR, receptacle:
J1	9-84135B01	female; coaxial; miniature type
		COIL, RF:
L1	24-84421B01	helical (WHT)
L2	24-84421B02	helical (YEL)
L3	24-84422B01	output (NAT)
		TRANSISTOR: (SEE NOTE)
Q1	48-869730	field effect; type M9730
		RESISTOR, fixed:
R1	6-129753	100 ±10%; 1/4 W
R2	6-185A15	39 ±5%; 1/8 W

NOTE:

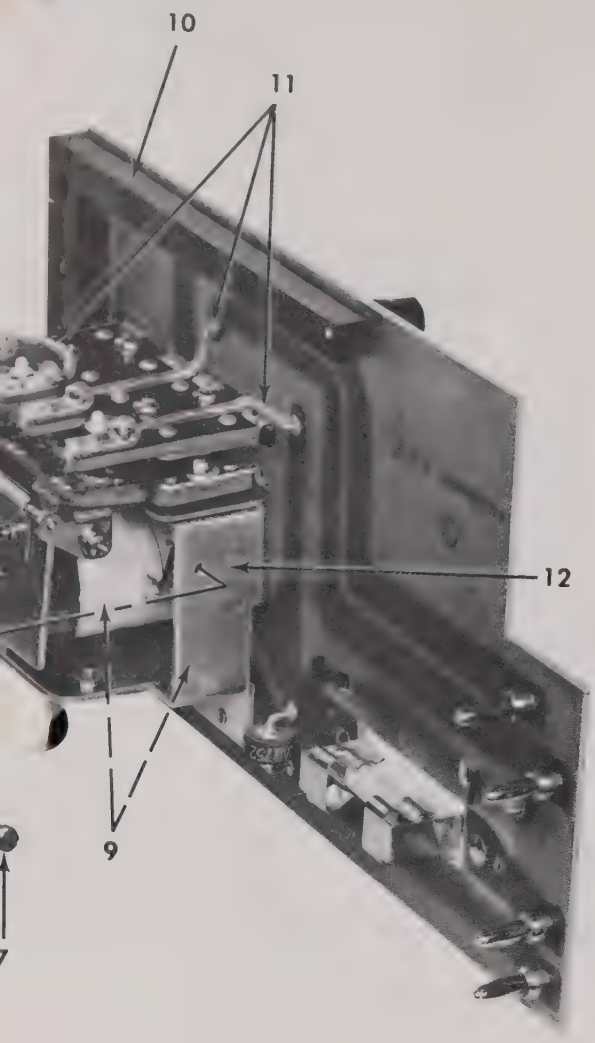
For optimum performance, replacement transistors must be ordered by Motorola part number.





CODE	MOTOROLA PART NO.	DESCRIPTION
TLD8752A RF Preamplifier		PL-1851-O
1	3-138768	SETSCREW, 10-32 x 3/4" lg.; 2 req'd.
2	2-83677G01	LOCKNUT; 2 req'd
3	7-84040E01	BRACKET
4	39-10184A24	CONTACT, receptacle
5	3-135111	SCREW, tapping; No. 4-40 x 3/8" lg., Phillips hex head; 7 req'd.
6	4-7607	WASHER, flat; .125 x .281 x .027"
7	4-858060	WASHER, insulator; 2 req'd.
8	1-80730A28	CONNECTOR ASSEMBLY
9	3-136926	SCREW, tapping, No. 4-40 x 5/16" lg., Phillips hex head 4 req'd.
10	15-84217E01	HOUSING
11	1-80733B97	CABLE ASSEMBLY: includes: 30-83794C01 CABLE, coaxial; 10" lg. 28-82365D02 CONNECTOR, plug, insulated 28-84237B02 CONNECTOR, plug
12	1-80733B98	CABLE ASSEMBLY: includes: 30-83794C01 CABLE, coaxial; 13" lg. 28-82365D02 CONNECTOR, plug; insulated 29-3018 LUG, soldering; No. 4

PARTS LIST



TLN4579A 13.6 V DC Direct Board PL-1342-O

CODE	MOTOROLA PART NO.	DESCRIPTION
1	55-84300B02	HANDLE, flat plastic: retractable
2	42-84284B01	RETAINER, screw: (BLK); 2 required
3	3-138517	SCREW, tapping: 4-40 x 7/16" Phillips round head (w/ext. lockwasher)
4	3-138515	SCREW, tapping: 4-40 x 5/8" Phillips round head (w/ext. lockwasher); 3 required
5	3-135996	SCREW, drive: No. 4 x 3/16" plain round head; 3 required
6	42-84284B02	RETAINER, screw: (RED); 2 required
7	3-82126B06	SCREW, machine: (nylon); 4-40 x 1/4" slotted round head; 2 required
8	15-84095D01	COVER, relay
9	3-132963	SCREW, machine: 8-32 x 1/4" Phillips round head; 2 required
10	43-84118D01	SPACER, board-mounting: plastic; BLK; "L"-shaped
11	37-127829	TUBING, insulating: "Teflon"; No. 16; clear (specify length when ordering)
12	7-84097D01	BRACKET, relay-mounting

ELECTRICAL PARTS LIST

TLN4575A 13.6 V DC Direct Board PL-1344-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
CR391	48D82525G13	SEMICONDUCTOR DEVICE, diode (SEE NOTE) silicon
F391	65S135013	FUSE, cartridge: 1-1/4" x 1/4" 20 A; 250 V
K391	80C84117D01	RELAY, armature: 4 form "C"; coil res 51 ohms ±10% does not include cover (see mechanical parts list)
P302		CONNECTOR, plug: consists of male contact terminals mounted on circuit board ("banana" type; Part No. 28B84029D01)

NOTE:

Replacement diodes must be ordered by Motorola part number only for optimum performance.

AUDIO FILTER BOARD

MODEL TLN4581A

1. DESCRIPTION

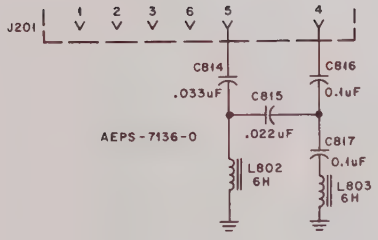
This audio filter circuit board can be used in carrier squelch radios to bypass the low frequency background noise of a PL tone present on the received carrier. The high-pass characteristics of this filter will allow voice signals above 300 Hz to pass but will block the lower frequency PL tones. Since this filter is connected in series with the audio signal path, the PL tones will not be heard in the speaker.

2. INSTALLATION

Physically, the audio filter board is plugged into the receiver audio and squelch board in the location normally occupied by the "Private-Line" decoder board in PL radio sets.

NOTE

WHEN USING THE AUDIO FILTER BOARD, JU201 ON THE RECEIVER AUDIO AND SQUELCH BOARD MUST BE REMOVED.



PARTS LIST

TLN4581A Audio Filter Board — PL-1345-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed: uF ±10%: 50 V; unl. stated
C814	8-82905G08	.033
C815	8-82905G02	.022
C816	8-82905G30	0.1
C817	8-82905G30	0.1
J201		for reference only
		COIL, RF: choke;
L802	24-84003A01	6 H
L803	24-84003A01	6 H
NON-REFERENCED ITEMS		
	9-83011H01	TERMINAL, pin: female; 6 req'd.
	3-138162	SCREW, lock: No. 4 x 3/8"; 2 req'd.
	42-84284B01	RETAINER, Nylon: 2 req'd.
	7-84223B01	BRACKET, retainer

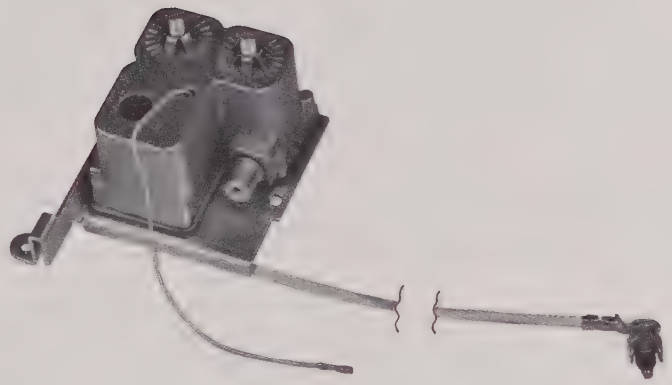
MOTOROLA INC. Communications Division
ENGINEERING PUBLICATIONS 1301 E. ALGONQUIN ROAD SCHAUMBURG, ILLINOIS 60172

Audio Filter Board
Circuit Board Detail
Motorola No. PEPS-7138-O
7/29/74-NPC

MOTOROLA

RF PREAMPLIFIER

MODEL TLD8752A



AEPS-9380-O

TECHNICAL CHARACTERISTICS

IMPEDANCE	50-ohm input, 50-ohm output
CURRENT DRAIN	7.5 mA at 13.8 V
FREQUENCY	150.8-174 MHz
POWER GAIN	10 dB

RECEIVER WITH PREAMPLIFIER

SENSITIVITY	-20 dB QUIETING	0.25 uV
	EIA SINAD	0.175 uV
SELECTIVITY (EIA SINAD)		-95 dB at ±30 kHz
INTERMODULATION (EIA SINAD)		-75 dB
SPURIOUS AND IMAGE REJECTION		-95 dB minimum
SQUELCH SENSITIVITY		Threshold 0.1 uV max. at 6 dB max. quieting Tight 0.6 uV max. at 14 dB min. quieting.

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ENGINEERING PUBLICATIONS 1301 E. ALGONQUIN ROAD SCHAUMBURG, ILLINOIS 60172

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7/29/74-NPC

68P81104E29
Issue - A

1. DESCRIPTION

The rf preamplifier is an optional accessory item that increases the useful operating range of the receiver. The preamplifier kit includes a printed circuit board, a housing, a feedthrough cable coupler, and two coaxial cables with rf phono-type connectors. The circuit board is plated on both sides, with components mounted toward the inside of the housing. The preamplifier circuit consists of two aperture-coupled helical resonators, an FET amplifier, and an output coil.

2. INSTALLATION

a. Tools Required

--#1 "Phillips" Screwdriver, or

--7/32" Nut Driver

b. Field Installation Procedure

If the rf preamplifier has not been factory-installed, proceed as follows:

(1) Disconnect power/control cable from the radio, and remove both top and bottom covers.

(2) Remove the power-supply deck from the bottom of the radio by loosening the red-capped screws. (These screws are indicated in Figure 16 in the Maintenance section of the manual supplied with the radio.) The power-supply deck may now be lifted out as a unit.

(3) Mount the preamplifer at the bottom rear of the radio using the two lockscrews provided. (See illustration.)

(4) Mount the feedthrough connector on the tab over the receiver rf and i-f board, as shown in the illustration.

(5) Disconnect the input lead from the rf preselector, and connect it to the end of the feedthrough connector nearest the preamplifier.

(6) Connect the shielded lead with phono connectors on both ends between the preamplifier input jack and the opposite end of the feedthrough connector. It should pass through the cut-out in the chassis frame.

(7) Connect the shielded lead from the preamplifier board output to the preselector input jack. The lead should pass through the cutout in the chassis frame, then through the hole in the chassis frame. The right-angle connector should mate with the preselector connector.

(8) Dress the two shielded leads between the transistor heat sink on the control board, and the chassis frame.

(9) Connect the preamplifier power (yellow) lead to the B+ pin on the control board (see illustration).

(10) Re-install the power-supply deck.

(11) Connect a power source to the radio set, and align the preamplifier according to the procedure described in the Maintenance paragraph of this section.

3. OPERATION

The incoming rf signal, applied to the antenna connector, is routed through the antenna switch receive contacts to the preamplifier input jack J1 through the receiver input cable. The input jack is connected to a tap on coil L1. The rf signal is coupled from L1 to L2 by utilizing the cavities in the housing to form two aperture-coupled helical-resonator cells. The tapped output of L2 is applied to a common-gate FET amplifier Q1. Output coil L3 provides loading for Q1 and is capacitively matched by capacitor C4 to output plug P2. This provides a 50-ohm termination for the input of the rf preselector.

4. MAINTENANCE

a. General

This section provides the maintenance shop type procedures for the rf preamplifier. These bench tests include measurements with a Motorola portable test set, and procedures for testing and troubleshooting.

b. Alignment

Disconnect the preamplifier input and output cables and bypass the preamplifier by connecting the receiver input cable, from the antenna switch, directly to the rf preselector input. Check and align the preselector according to the alignment procedure described in the receiver section of the manual. After the receiver has been aligned, disconnect the receiver input cable from the

preselector and reconnect the preamplifier input and output cables. While monitoring position 5, align the preamplifier for maximum meter indication by adjusting the tuning coils in the following order; L3, L2, L1. For final tuning, repeak L3, L2, and L1; then tune L2 for maximum quieting.

c. Realignment

It is not necessary to bypass the preamplifier when aligning to the same frequency or to a new frequency if it is within ±1.0 MHz of the previously-tuned frequency. Align the rf preselector first, then adjust the preamplifier as described in the preceeding paragraph.

d. Troubleshooting

With the preamplifier connected, and the test set on position 5, perform the following:

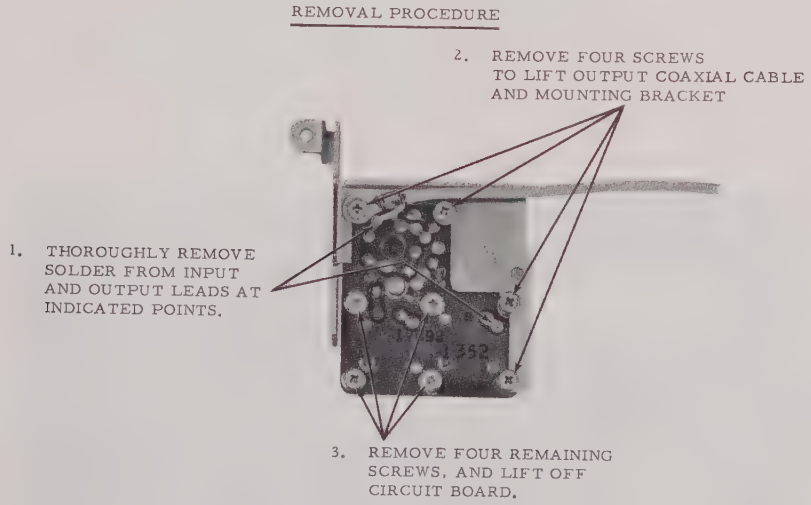
(1) Increase the signal generator output for a maximum indication on the test set meter (saturation), then decrease until a convenient reference point is reached on the test set meter (not more than 10 uA below the saturation point). Note both the test set meter indication and the signal generator output level setting.

(2) Disconnect the preamplifier input and output cables and bypass the preamplifier by connecting the receiver input cable, from the antenna switch, directly to the rf preselector input.

(3) Increase the signal generator output until the same reference point is obtained on the test set meter. Note the signal generator output level setting, it should be at least 3 times greater than the previous setting for a preamplifier gain of approximately 9-1/2 dB.

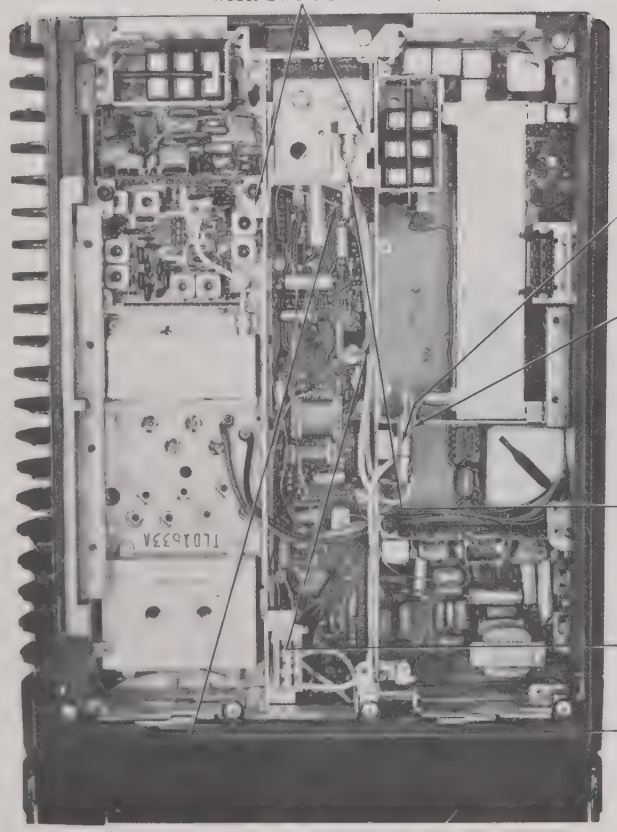
(4) Reconnect the preamplifier and check the alignment if the above indications are not obtained.

(5) If there is no output or insufficient gain after the preamplifier is aligned, check for faulty components or solder connections on the printed circuit board (refer to the circuit board removal and replacement illustration).



Preamplifier Circuit Board Removal and Replacement

Preamplifier Installation Detail



1. MOUNT PREAMPLIFIER WITH TWO LOCKSCREWS.

2. MOUNT FEEDTHROUGH CONNECTOR.

3. DISCONNECT INPUT LEAD FROM RF PRESELECTOR.

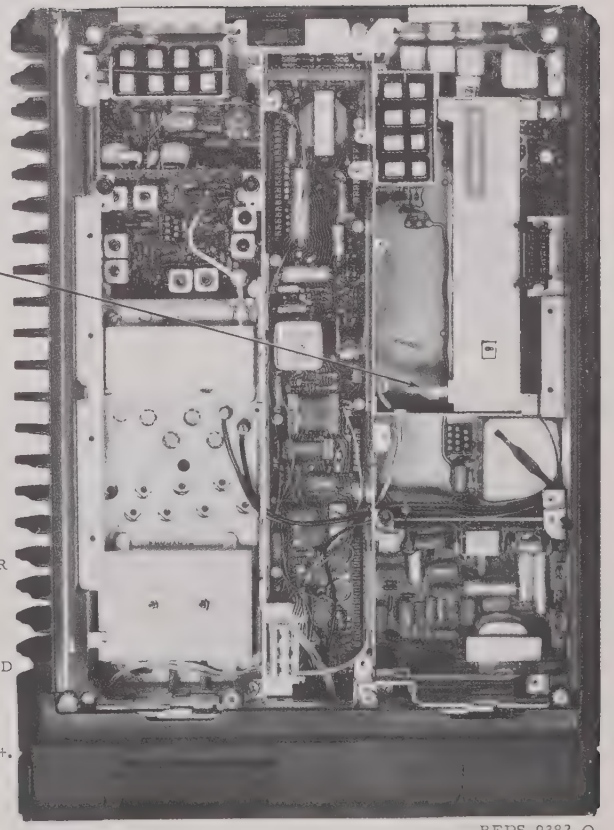
4. CONNECT INPUT LEAD TO END OF FEEDTHROUGH CONNECTOR NEAREST THE PREAMPLIFIER

5. CONNECT THE SHIELDED LEAD FROM PREAMPLIFIER TO THE PRESELECTOR INPUT (THROUGH THE HOLE IN CHASSIS FRAME).

6. CONNECT THE SHIELD ED LEAD WITH PHONO CONNECTORS ON EACH END BETWEEN THE PREAMPLIFIER INPUT AND THE FEEDTHROUGH CONNECTOR.

7. DRESS THE SHIELDED LEADS BETWEEN CHASSIS FRAME AND HEAT SINK.

8. CONNECT PREAMPLIFIER POWER LEAD (YELLOW) TO B+.



BEPS-9382-O

PARTS LIST

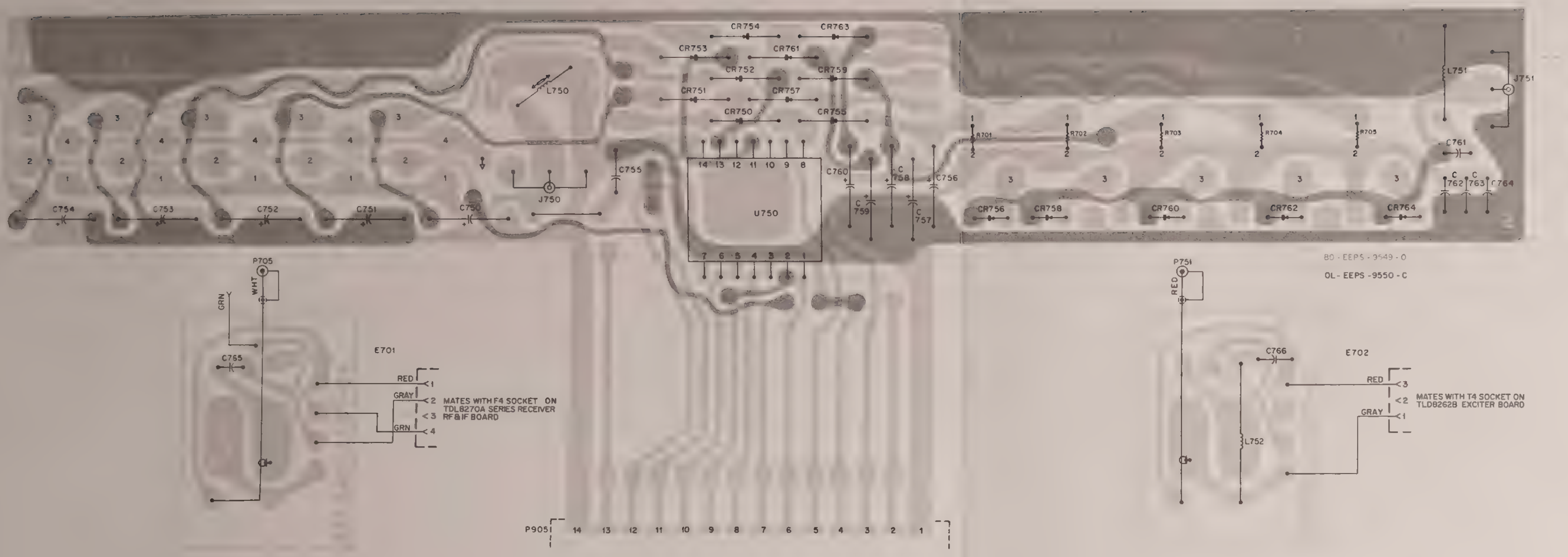
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
[illegible]	[illegible]	[illegible]
		SEMICONDUCTOR DEVICE, diode: SEE NOTE
CR7[illegible]	[illegible]	[illegible]
CR7[illegible]	[illegible]	[illegible], PIN type
CR7[illegible]	[illegible]	[illegible]
CR7[illegible]	[illegible]	[illegible], PIN type
CR7[illegible]	[illegible]	[illegible]
CR7[illegible]	[illegible]	[illegible], PIN type
CR7[illegible]	[illegible]	[illegible]
CR762	[illegible]	[illegible], PIN type
CR7[illegible]	[illegible]	[illegible]
CR764	[illegible]	[illegible], PIN type
		COIL, RF:
L750	24-84[illegible]	[illegible]
L751	24-82835G[illegible]	[illegible] μH
		CONNECTOR, receptacle:
J750, 751	[illegible]B02	single contact, [illegible]
		RESISTOR, fixed:
[illegible]	6-127803	1.5k ±[illegible] 1/4 W
		INTEGRATED CIRCUIT:
U750	[illegible]	hybrid circuit
	NON-REFERENCED ITEMS:	
	41-[illegible]G01	SPRING, [illegible], 1[illegible] req'd.
	7-84223B01	BRACKET, [illegible]
	[illegible]H01	CONTACT, receptacle; 14 req'd.
	29-[illegible]	PIN, terminal; 36 req'd.
	[illegible]A[illegible]	CONTACT, terminal
	[illegible]A01	SHIELD, [illegible]

TLN4914A Hardware Kit PL-19[illegible]-A

		CAPACITOR, fixed:
C7[illegible]	21-84[illegible]H01	.01 μF ±[illegible] V
C7[illegible]	23-82[illegible]D17	15 μF ±2[illegible], 2[illegible] V
E701	1V80733B76	HOUSING ASSEMBLY (Receiver Interconnect) incl. ref. item C7[illegible]
E702	1V80733B77	HOUSING ASSEMBLY (Transmitter Interconnect) incl. ref. items C766, L752
		COIL, RF:
L752	24-82835G28	[illegible] 15 μH

NOTE:

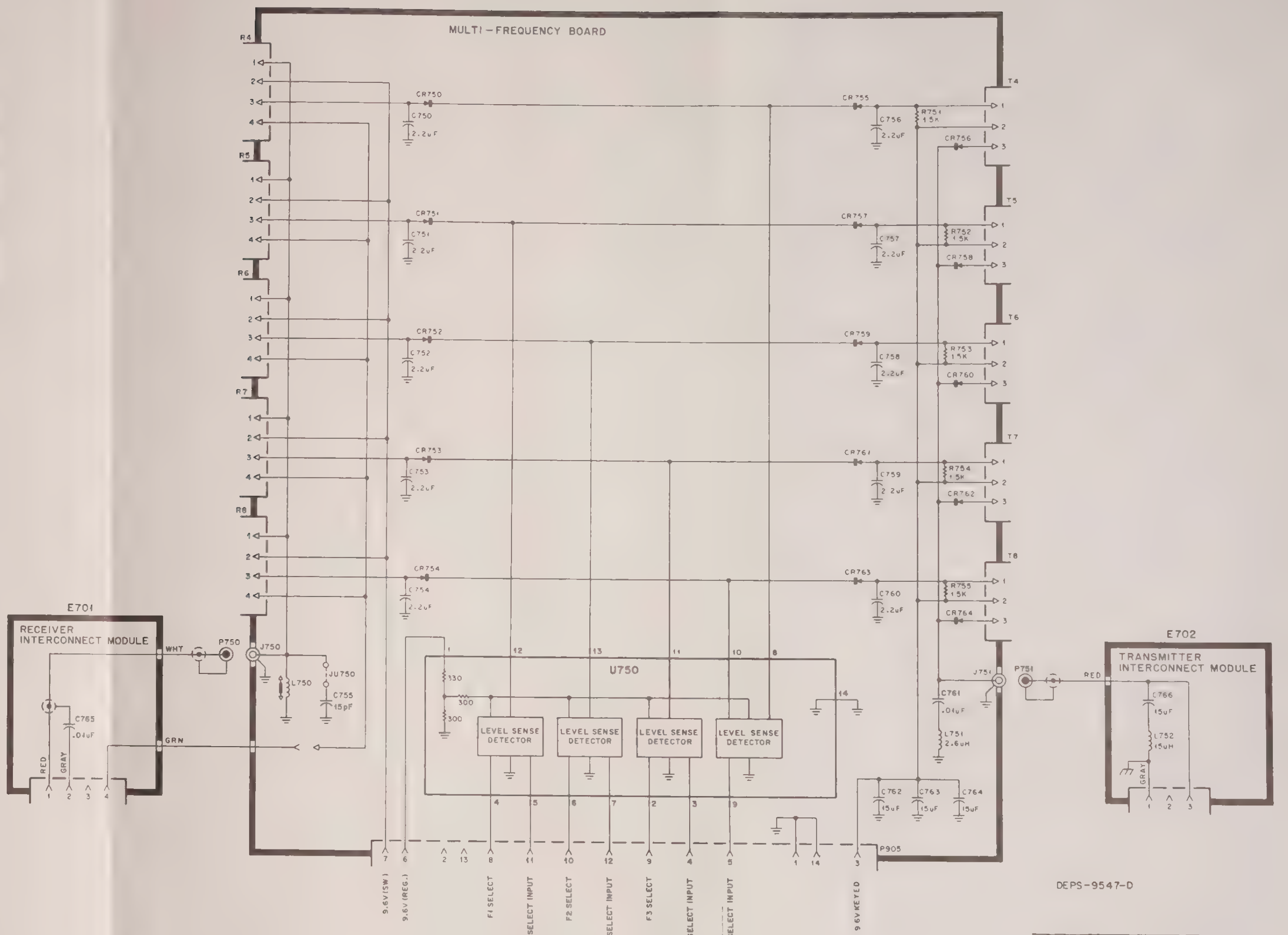
For optimum performance, replacement diodes must be ordered by Motorola part number.



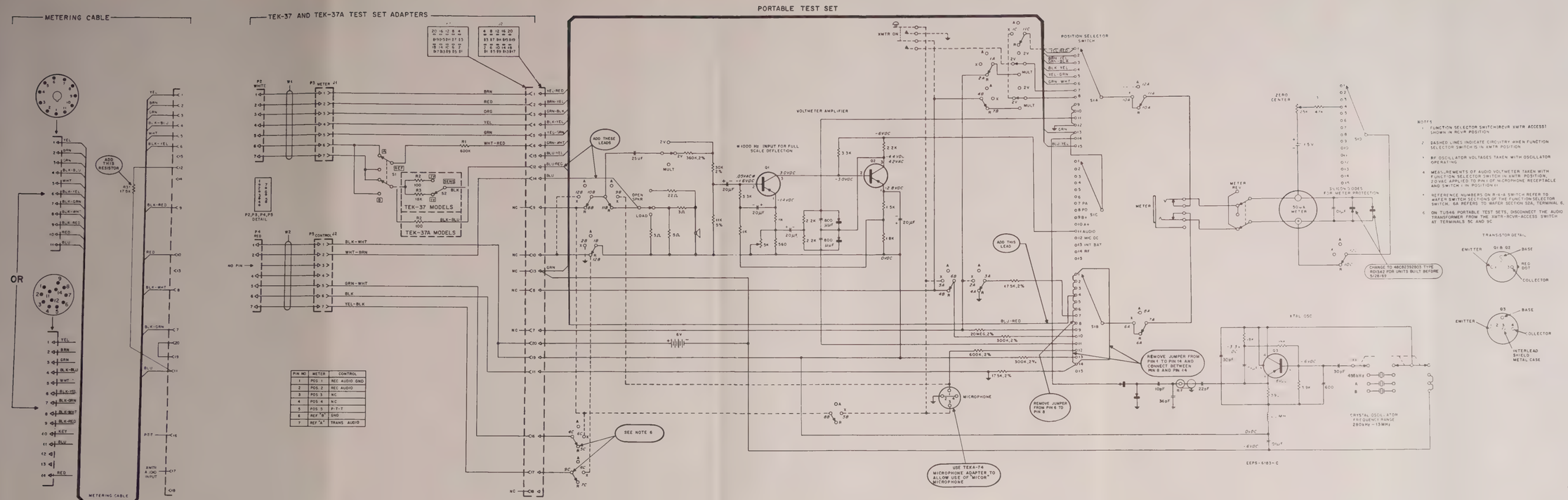
REVISIONS

PEPS-9546-C

CHASSIS AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
TLN4872A	U750	FROM 51-84312B84 TO 1V80740B20	PART LIST
TLN4914A	C765	ADDED 21-84008H01, .01 uF	E701
	C766	ADDED 23-82397D17, 15 uF	E702
	L752	ADDED 24-82835G28, 15 uH	
TLN4872A-1	R1 THRU R5	ADDED 6-127803, 1.5k ±10%; 1/4 W	XMTR. CH. ELEMENT SOCKETS, PINS 1 & 2



Eight-Frequency Modification Kit
Schematic Diagram and
Circuit Board Detail
Motorola No. PEPS-9546-C



Motorola Portable Test Set
And TEK-37 or TEK-37A Test Set Adapter
Simplified Circuit Diagram
Motorola No. EEPS-6183-C
7/29/74-NPC

MAINTENANCE

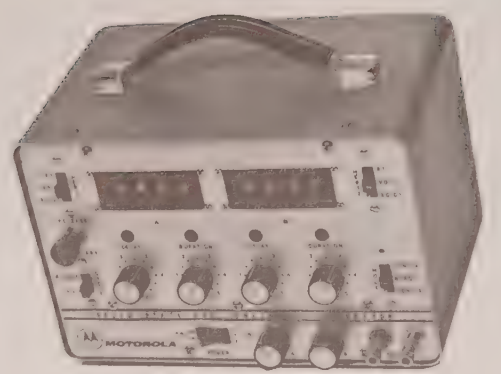
TABLE OF RECOMMENDED TEST EQUIPMENT

TYPE OF EQUIPMENT OR TYPE OF MEASUREMENT	EQUIPMENT CHARACTERISTICS	RECOMMENDED TYPE
All	Select battery operated test equipment where available, for versatility.	See your Motorola sales representative before ordering test equipment. He will analyze your requirements and help you select your latest available equipment to suit your individual needs. He can also advise you of new servicing equipment which becomes available after the printing of this manual.
Power Supply for Bench Testing	Transmit: (for 45 W Transmitter) 13.6 V DC @ 17 A or 72 V DC @ 3.5 A or 117 V RMS @300 W Receive (standby): 13.6 V DC @.7 A or 72 V DC @.28 A or 117 V RMS @50 W	Motorola Model T1012A and T1064A Filtered DC Power Supplies, or any other dc supply or battery bank with similar ratings. Variable transformer (VARIAC) 0-140 V AC. Motorola Model ST860 AC Line Monitor.
Test Harness for Bench Testing	Must simulate conditions of installation including fusing, volume control, frequency selection, speaker loading.	Standard AAR Control Head with Railroad Handset and TKN6044A Bench Test Cable Kit, and TEKA-80 Adapter Cable (when Power Supply Deck is removed from radio).
Portable Test Set or Meter Panel	No equivalent. Use only recommended type.	Motorola S1056A to S1059A Series Portable Test Set (if you have a Model TU546, it may be used) with TEK-37 or TEK-37A Test Set Adapter. TEKA-74 Microphone Adapter allows "Micor" microphone to be used with test set. Motorola TEK-5B or TEK-5C Meter Panel with TEK-40 Conversion Kit.
Transmitter Frequency Measurement	Frequency - 150.8 to 174 MHz Accuracy - ±.00005% or better	Any of the following items of Motorola Test Equipment: Model S1327A Service Monitor Model S1315A Frequency Calibrator Model S1324A Digital Frequency Meter Model S1325A Digital Frequency and Deviation Meter Model S1317A or S1322A Digital Frequency/Period Counter
Transmitter Deviation Measurement	Peak reading type for voice or sinusoidal wave; scales for accurate reading of ±5 kHz deviation (and ±1 kHz deviation for "Private-Line" models)	Any of the following items of Motorola Test Equipment: Model S1327A Service Monitor Model S1326A Frequency Calibrator and Deviation Meter Model S1323A Deviation Meter Model S1325A Digital Frequency and Deviation Meter Model S1059A Portable Test Set
Transmitter Power Output Measurement	150.8-174 MHz; 50 ohms; at least 0-75 watts. 50-ohm dummy load; at least 100 watts	Motorola S1056A to S1059A Portable Test Set Motorola Model T1001A (Bird Model 43) "Thruline" Wattmeter with appropriate element Motorola Model T1013A RF Load Resistor Motorola Model S1327A Service Monitor with SLN1009A Wattmeter Plug-In Module
RF Signal Generator for receiver testing	150.8 to 174 MHz; FM; high-stability-(±.0002% or better); adjustable output 0 to 1000 microvolts	Motorola Model S1327A Service Monitor Motorola S1318A Series Solid-State FM Signal Generator
Audio Voltage Measurements	High impedance (10 megohm); dBm scale	Motorola Model S1053C Solid-State AC Voltmeter
Audio Signal Generator for audio circuit testing in receiver and transmitter	Variable amplitude 0 to 1 volt; 100 Hz tone (300 to 3000 Hz preferred); sinusoidal wave	Motorola Model S1067A Solid-State Audio Oscillator Motorola Model TEK-1A Tone Oscillator Motorola S1327A Service Monitor
DC Voltage Measurements, Resistance Measurements, RF Voltage Measurements	High impedance (11 megohm) dc multimeter	Motorola Model S1063A Solid-State DC Multimeter with SLN6055A RF Probe Motorola Model T1048A Digital Multimeter
Waveform Measurements	Oscilloscope: Audio circuit measurements RF circuit measurements, at least 50 MHz bandwidth	Motorola Model T1038A General Purpose Oscilloscope. Motorola Model S1331A or S1332A Solid-State Oscilloscope A very high quality instrument is required
"Private-Line" tone injection for PL decoder circuit measurements	"Private-Line" tone generator using "Vibrasender" resonant reed for frequency accuracy; or audio oscillator with frequency counter for accurate setting of oscillator	Motorola Model S1333A Audio Synthesizer Motorola Model SLN6221A "Private-Line" Tone Generator

S1327AC SERVICE MONITOR
RF, IF, and Audio Frequency Generation
RF Frequency Measurement
Deviation Measurement

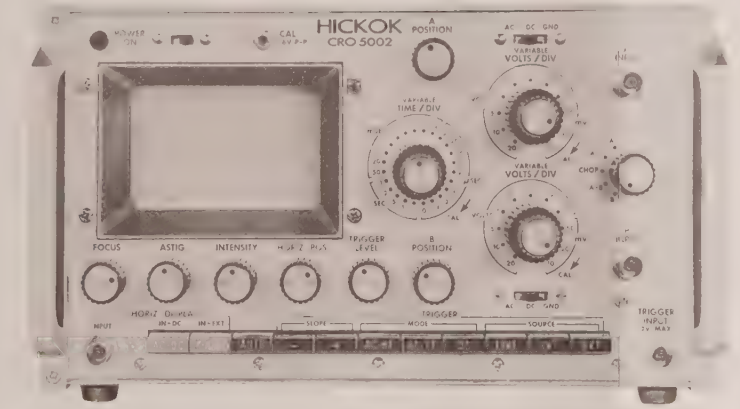
S1325A DIGITAL FREQUENCY
& DEVIATION METER
8-Digit Readout, 50 Hz - 525 MHz
High Resolution and Sensitivity

S1326A FREQUENCY
CALIBRATOR & DEVIATION
METER
High Resolution Heterodyne Type
Frequency Meter
Also sets Receivers On-Frequency

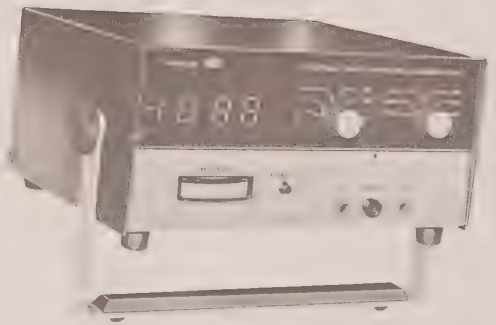


S1333A AUDIO SYNTHESIZER
Precision Tone Generation

S1318A FM SIGNAL GENERATOR
RF & IF Signal Generation
and Modulation

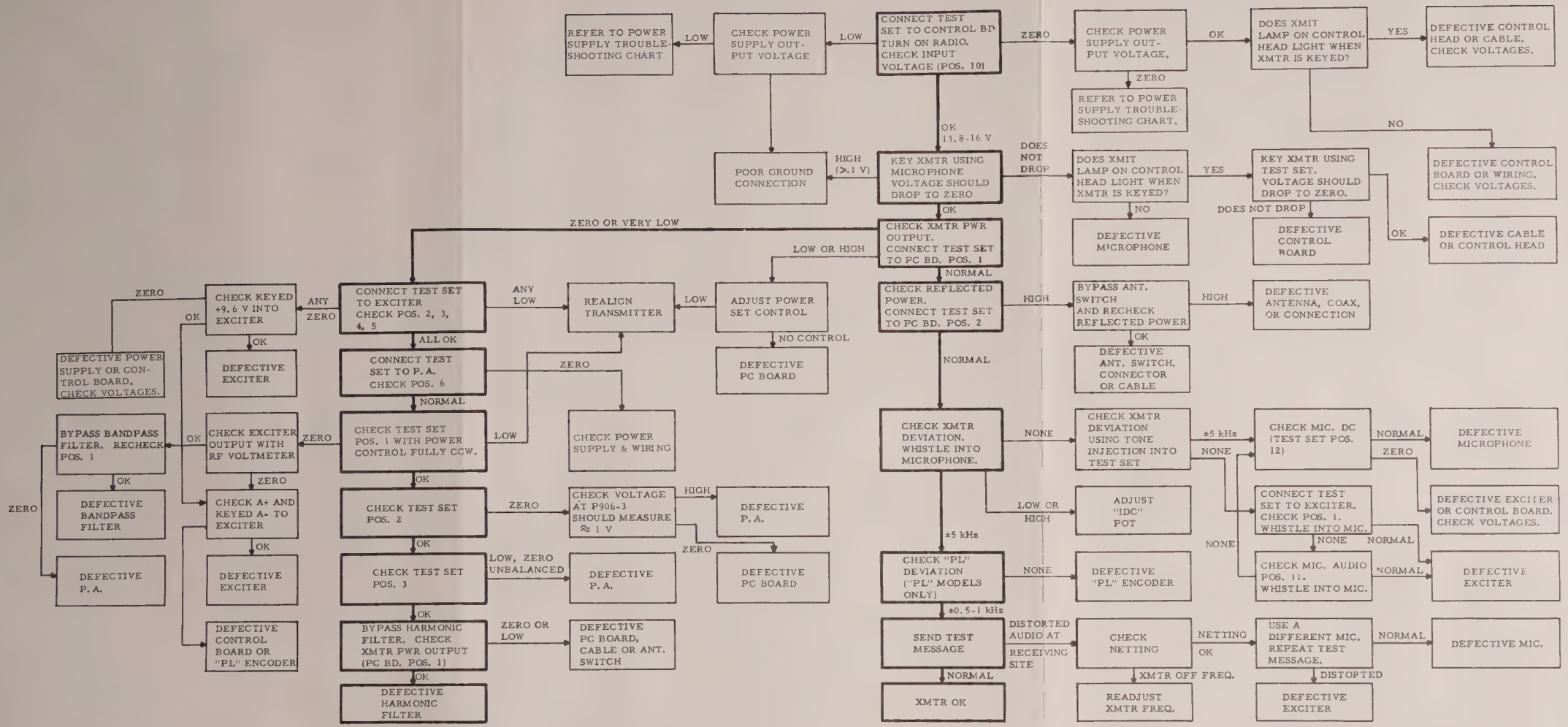


S1332A DUAL CHANNEL OSCILLOSCOPE
Solid-State 25 MHz Bandwidth
(Single Trace Model is S1331A)

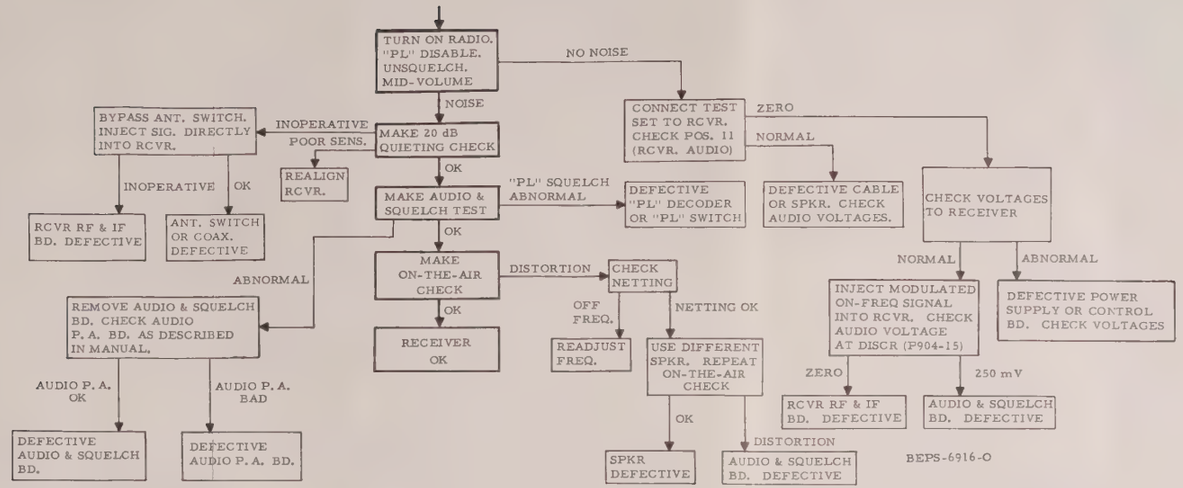


T1048A DIGITAL MULTIMETER

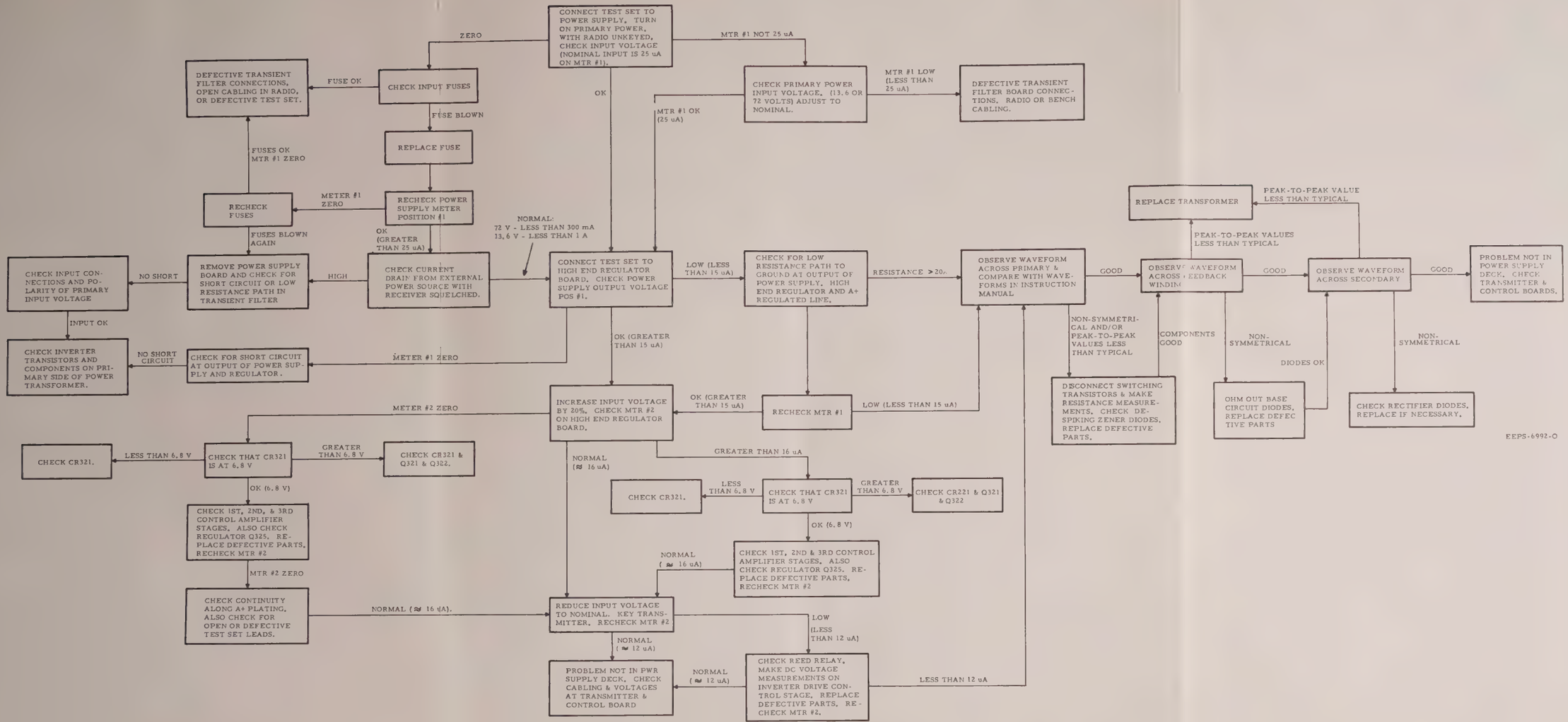
TRANSMITTER TROUBLESHOOTING CHART



RECEIVER TROUBLESHOOTING CHART

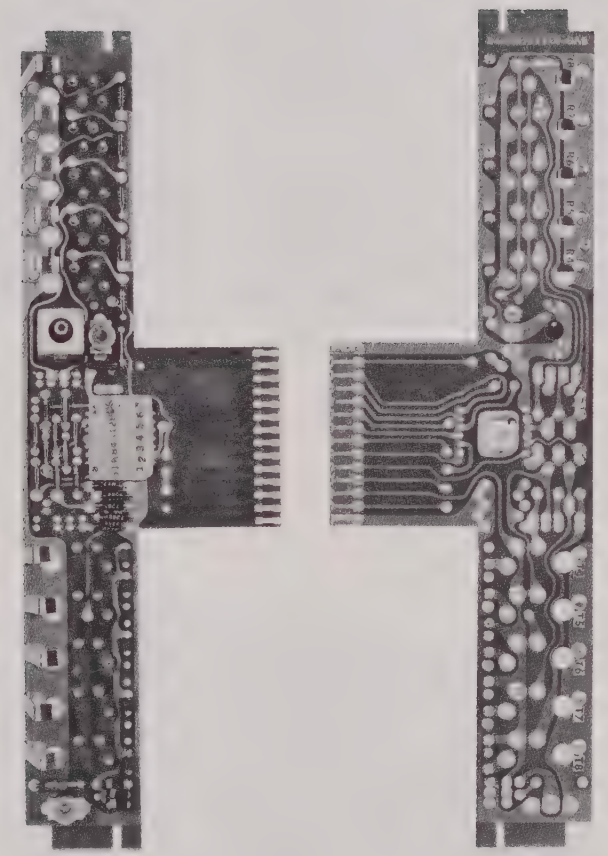


POWER SUPPLY TROUBLESHOOTING CHART



EIGHT-FREQUENCY MODIFICATION KIT

MODEL TLN1533A



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TECHNICAL CHARACTERISTICS

RF FREQUENCY RANGE	150.8-174 MHz
NUMBER OF CHANNELS	5 to 8
TRANSMITTER PORTION:	
MAXIMUM CHANNEL SEPARATION	±750 kHz
OSCILLATOR FREQUENCY	12.5-18.055 MHz
RECEIVER PORTION:	
CHANNEL SPACING	30 kHz
OSCILLATOR FREQUENCY	15.455-18.055 MHz
POWER REQUIREMENTS	Regulated 9.6 volts @20 mA

1. DESCRIPTION

The eight-frequency modification kit provides the facilities to increase the number of operational channels of a railroad "Micor" radio set up to a total of eight channels. The modification kit may be easily field installed, or it may be factory installed as part of an eight-channel radio set.

The modification kit consists of a multi-frequency circuit board and a hardware kit. The multi-frequency circuit board is "T"-shaped and mates with J905 near the rear of the radio set control board. The center portion of the board contains the channel selection circuitry. The "arm" portions of the board provide the mounting facility for the channel elements for the fourth through eight channels. The channel elements for the first three channels keep their original mountings on the exciter and receiver circuit boards. The channel elements for the fourth channel on the exciter and receiver circuit boards are replaced with interconnect modules. These interconnect modules are used to couple the rf energy from the multi-frequency board to the exciter and receiver boards. The hardware kit includes the two interconnect modules, two slide brackets, a shield with mounting bracket, a guide post and six screws.

NOTE

Channel elements for the additional channels are not supplied with this modification kit and must be ordered separately.

2. FIELD INSTALLATION

a. Tools Required

--#1 "Phillips" Screwdriver

--3/16" Flat-Tip Screwdriver

b. Installation Procedure

(1) Disconnect the power/control cable from the radio set.

(2) Remove both the top and bottom covers. Refer to the Maintenance section of the radio set manual for cover removalprocedure, if not known.

(3) Remove the 72 volt power supply by loosening its securing screws, or if even greater access is desired, remove the power supply deck from the bottom of the radio set chassis by loosening the red-capped screws. Refer to Figure 16 in the Maintenance section of the radio set manual for the location of these screws. The power supply deck may be lifted out of the chassis as a single unit.

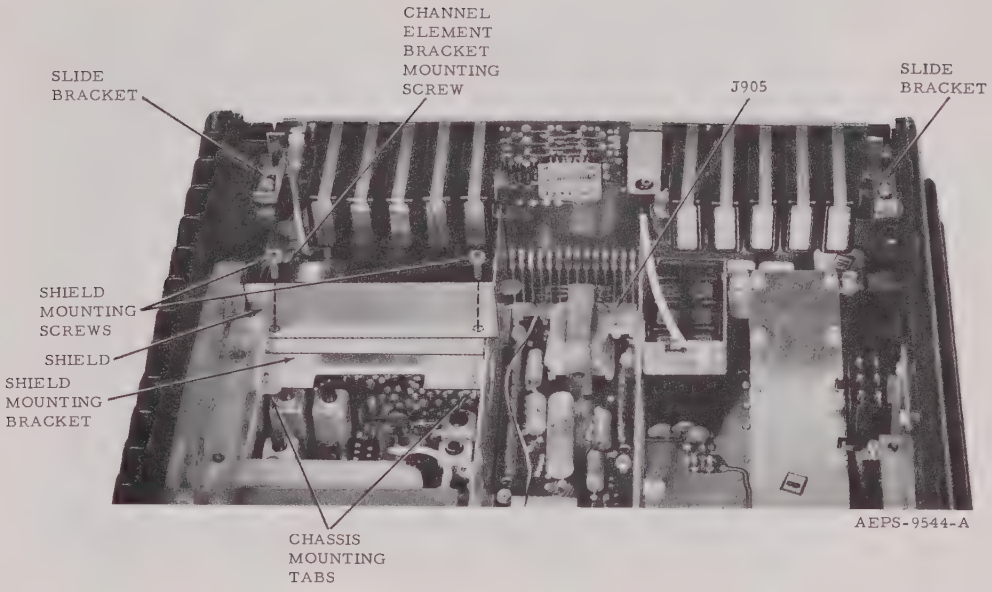
(4) Remove the protective covering from the top of J905 which is located near the rear of the radio set control board.

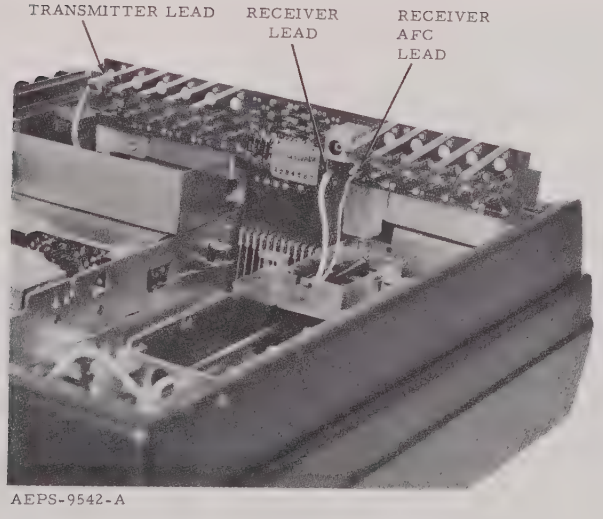
(5) Cut jumpers JU901, JU902 and JU903 on the control board. (See Diode and Jumper Location detail.) Add jumper provided across C901 on the control board.

(6) On radio sets equipped with four channels, remove the R4 and T4 channel elements and install them into their respective positions on the multi-frequency board.

(7) Install the channel elements for the remaining channels in their respective positions on the multi-frequency board. When less than the full complement of channel elements is used, jumpers may be added across the channel select diodes to avoid "blank" channels. Refer to the following Channel Select Jumpers portion of this section for details.

(8) When two or more receive channel elements are installed on the multi-frequency board, cut jumper JU750 on the board.





Modification Kit Installation Detail

(9) Install the receiver and transmitter interconnect modules into the fourth channel element position on the receiver and exciter circuit boards. (The receiver interconnect module has two leads.)

(10) Place the shield mounting bracket provided on the chassis mounting tabs located above the "PL" encoder board. Refer to the Modification Kit Installation Detail for the location of these tabs. Align the mounting hole in each bracket tab with the forward hole (toward front of radio) in each chassis mounting tab. In "Private-Line" radios, the rear hole in each chassis mounting tab is used to mount the "PL" encoder board. Secure the bracket in place with two of the self-tapping screws provided.

(11) Remove the screw securing the transmitter channel element mounting bracket to the side heat sink. Save this screw for use in next step.

(12) Place the shield provided onto the bracket just installed. Slide the shield guide tab between the transmitter channel element bracket and the heat sink. Align the two holes in the shield with the two holes in the bracket. Secure the shield with two of the self-tapping screws provided and the screw removed in the preceding step.

(13) Align the female pins on the multi-frequency board with the long pins of J905 on the control board and slide the board into the radio set.

(14) Insert the guide screw provided through the bracket on the rear of the multi-frequency board; align with pre-drilled chassis hole and tighten.

(15) Connect the cables from the interconnection modules into their respective jacks on the multi-frequency board. Refer to the Modification Kit Installation Detail for the location of these jacks.

(16) Install the two slide brackets with two of the self-tapping screws provided on the two unused chassis mounting tabs at the rear of the radio. Push in slide brackets to secure the multi-frequency board in place.

(17) Reinstall the power supply / or power supply deck on the radio set.

(18) Align the multi-frequency board following the procedure described in the Alignment portion of this section.

3. CHANNEL SELECT JUMPERS

Radio sets having less than a full complement of eight transmitting and eight receiving channels are possible by adding jumpers across the frequency select diodes similar to the method described in the Control Board section of the radio set manual. The channels are separated into two groups for channel strapping purposes; Group #1 for channels 1 through 3 and Group #2 for channels 4 through 8. Either of these groups may repeat the same frequency on two or more channels by adding the appropriate jumper(s) and sharing one common channel element. No provision has been provided for selecting the same frequency in both groups unless a second channel element on the same frequency is used in the second group.

EXAMPLE

Channel Selection Desired:

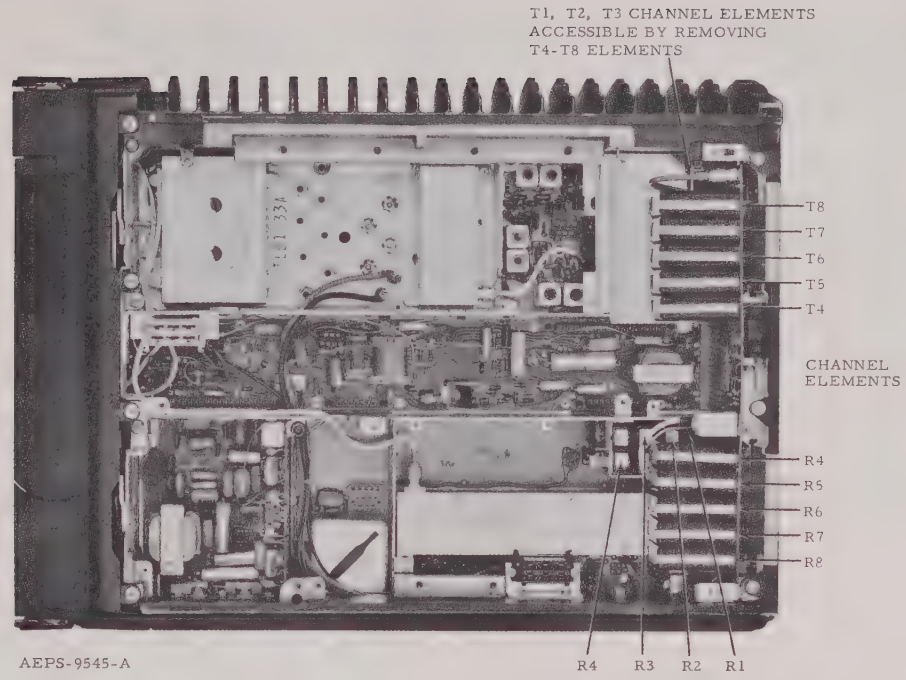
Channel	Frequency	Channel	Frequency
T1	F1	R1	F1
T2	F2	R2	F2
T3	F1	R3	F3
T4	F2	R4	F4
T5	F1	R5	F5
T6	F2	R6	F6
T7	F1	R7	F7
T8	F2	R8	F8

Procedure:

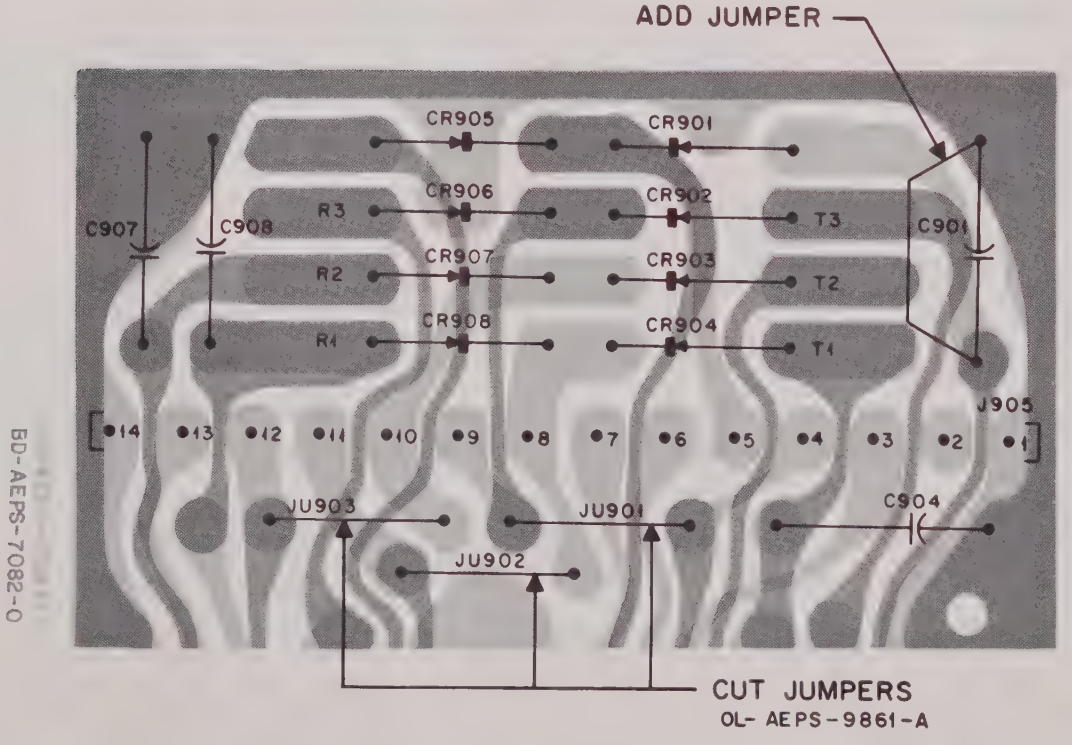
Jumper point T3 to T1 on the control board. Insert F1 channel element in the T1 position on the exciter board. Insert F2 channel element in the T2 position on the exciter board. Leave the T2 position empty.

Jumper point T7 to T5 on the multi-frequency board. Insert a second F1 channel element in the T5 position on the multi-frequency board. Jumper point T8 to T6 to T4 on the multi-frequency board. Insert a second F2 channel element in the T4 position on the multi-frequency board. Leave the T6, T7 and T8 positions empty.

Insert the channel elements for R1 through R8 in their respective positions on the receiver and multi-frequency boards.



Channel Element Location Detail



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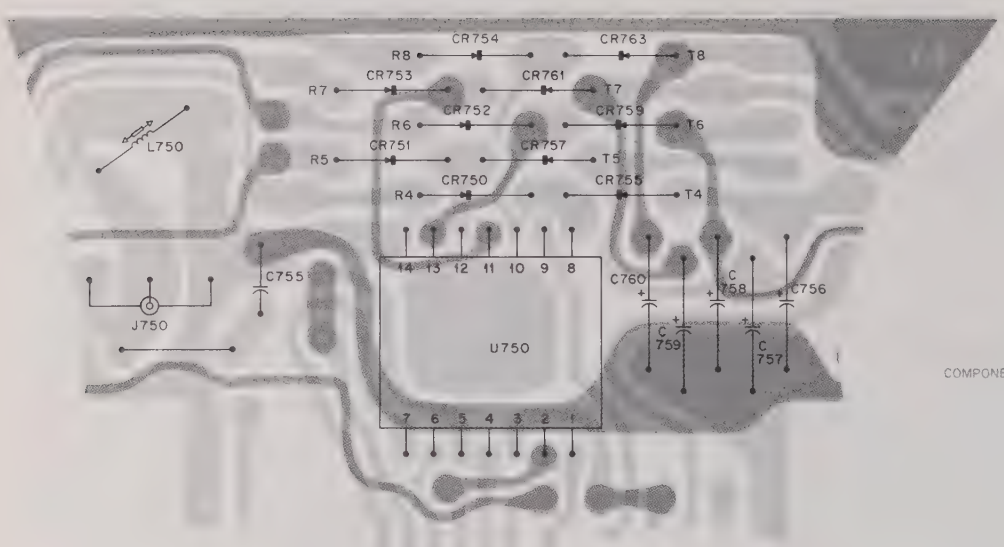
Control Board Diode and Jumper Locations



Multi-Frequency Board Diode Locations

NOTE

FCC approval is required before adding or changing transmitter frequencies.

4. ALIGNMENT

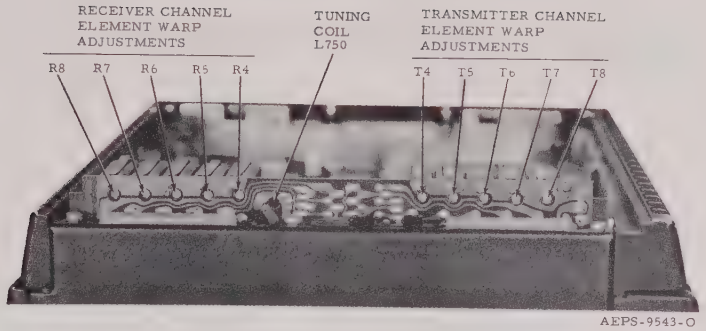
a. Exciter

Align the exciter in the same manner as described on the Exciter Alignment Procedure contained within the radio set manual. Set the T4 through T8 channel elements on frequency (warp) following the Oscillator Frequency Adjustment portion of the Exciter Alignment Procedure.

b. Receiver

Align the receiver in the same manner as described on the Receiver Alignment Procedure contained within the radio set manual except replace Step 1 with the following:

STEP	ADJUST	SELECTOR SWITCH POSITION	OSC. & METER REV. SWITCH	STAGE AND PROCEDURE
1a.	L750	-	-	Adjust L750 on the multi-frequency board so that the slug is flush with the board. Set the control head frequency selector switch to F5. If center-frequency tune-up crystal is available, install in the R5 position on multi-frequency board.
1b.	L108 L109	3	METER REV.	CHANNEL ELEMENT OUTPUT (3rd HARMONIC). Adjust L108 and L109 for maximum test set meter reading.
1c.	L750	3	METER REV.	Adjust L750 for a 5 mA decrease in test set meter indication. If a 5 mA decrease cannot be obtained, adjust L750 for first minimum reading.
1d.	L108 L109 L750	3	METER REV.	Adjust L108, L109 and L750 in that order for maximum test set meter reading. Repeat L108, L109 and L750 adjustment.



Multi-Frequency Board Alignment Points

5. OPERATION

a. Frequency Selection

Eight channel selection is accomplished using a special thick-film, hybrid circuit. This hybrid circuit is voltage level sensitive and translates switched ground or switched A+ into two separate switched ground outputs. Four voltage level detectors are contained within the hybrid circuit. Thus, eight separate outputs are available for channel selection purposes from the two voltage levels applied to the four inputs. Channels one through four are selected from the associated control head using switched ground and channels five through eight using switched A+. Isolation diodes in the channel selection output leads of the hybrid circuit prevent dc interaction between the channel elements.

b. Transmitter Frequency

The transmitter channel element oscillator frequency is the same as the fundamental crystal frequency. The rf energy is coupled from the multi-frequency board into the exciter ramp generator via the interconnect module. A diode in the output of each channel element isolates the loading effect of the unselected channel elements from that of the selected channel element.

c. Receiver Frequency

The receiver channel element frequency is the third harmonic of the fundamental crystal frequency. The rf energy is coupled from the multi-frequency board into the receiver multiplier circuit via the interconnect module. The impedance of the multi-frequency board is matched to the impedance of the receiver with L750 and C755.

6. TROUBLESHOOTING

a. Isolating Defective Component

If the transmitter and/or the receiver channel element output test set reading is abnormal, or tests indicate sub-normal performance a logical troubleshooting procedure is required to isolate the defective component. The accompanying troubleshooting charts summarize these procedures in a logical sequence.

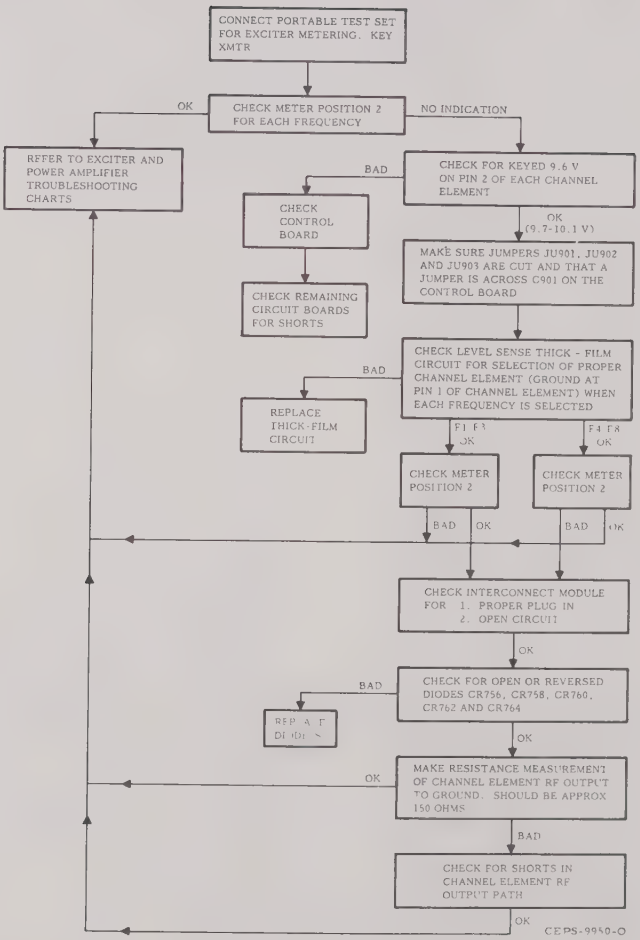
b. Troubleshooting Thick-Film Circuits

Thick-film circuits are very reliable components and should not be replaced until all checks have proven definitely that the thick-film circuit is the defective component. Before replacing a bad thick-film circuit, make sure that the external components in the circuit are normal. Otherwise, the conditions which cause the failure may still be present and destroy the new thick-film circuit.

If the thick-film circuit is replaced, use a "desoldering" iron with a vacuum bulb to remove solder.

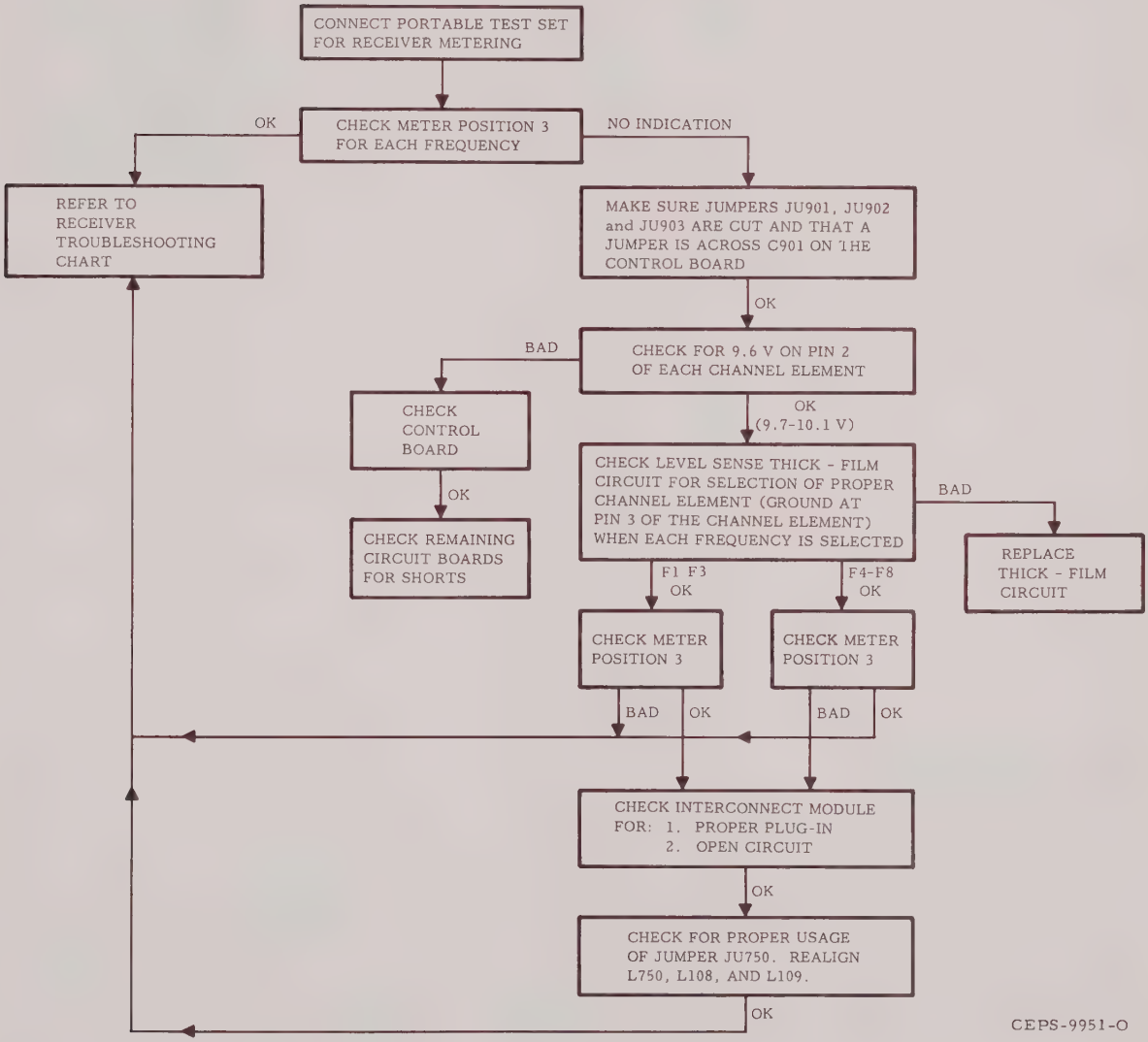
EXCITER PORTION

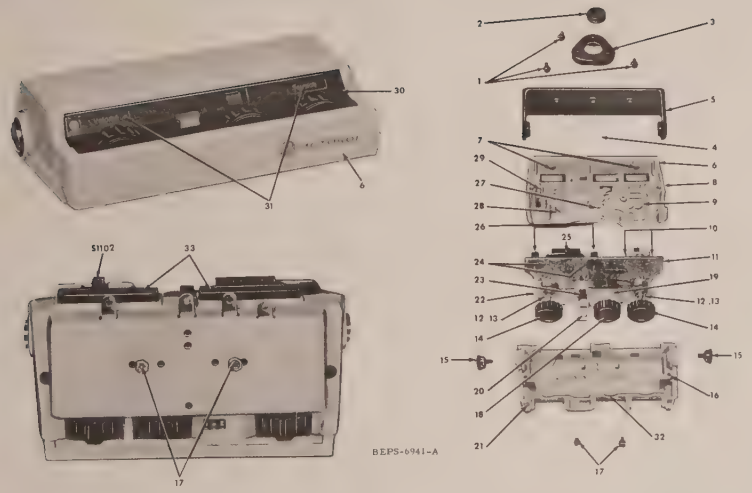
TROUBLESHOOTING CHART



RECEIVER PORTION

TROUBLESHOOTING CHART





MECHANICAL PARTS LIST

IMPORTANT

USE ONLY THE FOLLOWING MOTOROLA PART NUMBERS WHEN ORDERING REPLACEMENT PARTS

CONTROL HEAT MODELS

TCN1091B (Single-Freq.)	†TCN1106A (8-Freq.)
TCN1092B (4-Freq.)	†TCN1112A (8-Freq.)
TCN1095A (Single-Freq.)	†TCN1119A (12-Freq.)
TCN10961 (4-Freq.)	†TCN1124A (12-Freq.)
	†TCN1184A (5-Freq.)

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CODE NUMBER	MOTOROLA PART NO.	DESCRIPTION
1	3S136756	SCREW, tapping; 10-16 x 5/8" plain hex flanged head; does not include 4S7652 LOCKWASHER; No. 10 external
2	49C84961C01	DISC, trunnion bracket mounting; "breakaway" type (TCN1091B and TCN1092B)
3	42D84963C01	COLLAR, trunnion bracket mounting (TCN1091B, TCN1092B)
4	3S115727	LOCKSCREW, machine, 10-32 x 1/2" plain hex head (TCN1091B, TCN1092B)
5	7C84576B01	BRACKET, trunnion (TCN1091B, TCN1092B)
6	75B84628B01	FRONT COVER, housing ("bumper")
7	3S136963	SCREW, tapping: 6-20 x 5/16 "Phillips" flat head
8	1V80712B88	TOP COVER ASSEMBLY, housing; includes items coded 5, 7, 9, 27, 28, 29, 31 (multi-freq. models)
	or	
	1V80757B65	TOP COVER ASSEMBLY, housing; includes items coded 5, 7, 9, 28, 29 and 31 (single-freq. models)
9		PRISM, optical (SEE NOTE)
10	3S129675	LOCKSCREW, 4-40 x 1/4 "Phillips" binder head with lockwasher
11	TLN4369B	PLATED CIRCUIT BOARD ASSEMBLY; includes contact terminals
12	2S136272	NUT, machine; 3/8-32 x 1/2 hex
13	4S8210	WASHER, metallic, 0.497" x 0.562" x 0.16"
14	36D84001C02	KNOB, control (volume & squelch
15	3B84546B01	SCREW, machine; shoulder type (trunnion-mount)
16	3B84548B01	SCREW, machine; 6-32 x 1/2 "Phillips" round head; "captive type
17	3S136138	LOCKSCREW, machine; 6-32 x 7/8 "Phillips" hex head
18	36D84001C01	KNOB, control; (freq. selector) (requires use of item coded 19)
19	36D84006C01	DISC, switch position indicator (used with item coded 18)
20	45C84004C01	ACTUATOR, switch
21	15E84920B01	HOUSING, (bottom section)
22	7C84005C01	BRACKET (chassis
23	1V80712B89	SWITCH ASSEMBLY (slide switch); includes wires, contact terminals and mounting screws
24	3S135084	LOCKSCREW, tapping; 4-40 x 5/16" "Phillips" fillister head
25	42D84067C01	RETAINER, connector
26	9B84627B01	LAMPHOLDER
27, 28		PRISM, optical (SEE NOTE)
29		PRISM, optical; includes RED LENS (SEE NOTE)
30	13D84000C02 or 13D84000C01	BEZEL (single-frequency) BEZEL (multi-frequency)
31	33C84038C01	MARKER STRIP (VOLUME, SQUELCH)
32	38B84357C01	PLUG, SNAP-IN (single-freq.)
33	42C84962C01	RETAINER, connector

REFERENCE SYMBOL	MOTOROLA PART NO	DESCRIPTION
		NON-CODED ITEM
	54B84111D01	MOUNTING TEMPLATE (TCN1091B, TCN1092B)

NOTE: Items coded 9, 27, 28 and 29 are not individually replaceable. For field-replacement, order item No. 8 (TOP COVER ASSEMBLY).

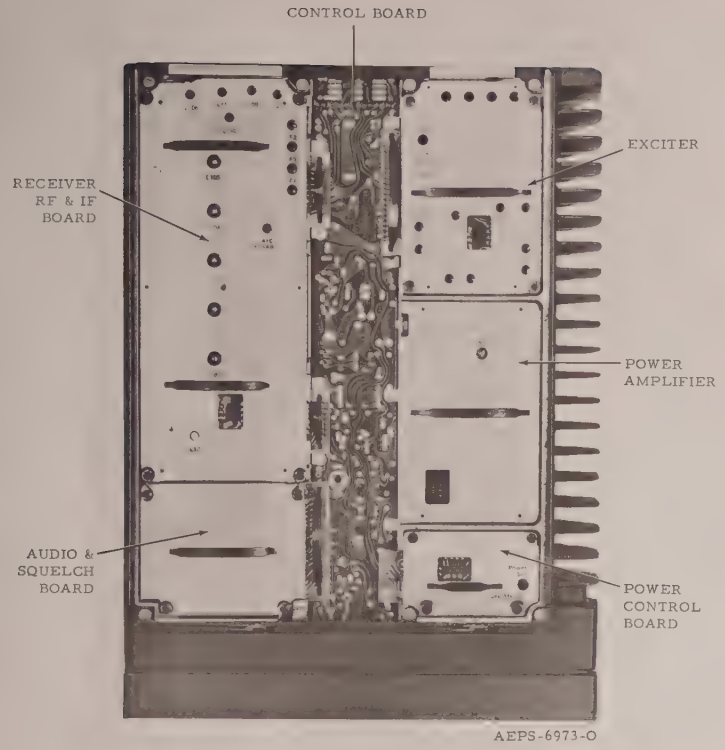
ELECTRICAL PARTS LIST

PL-1049-F

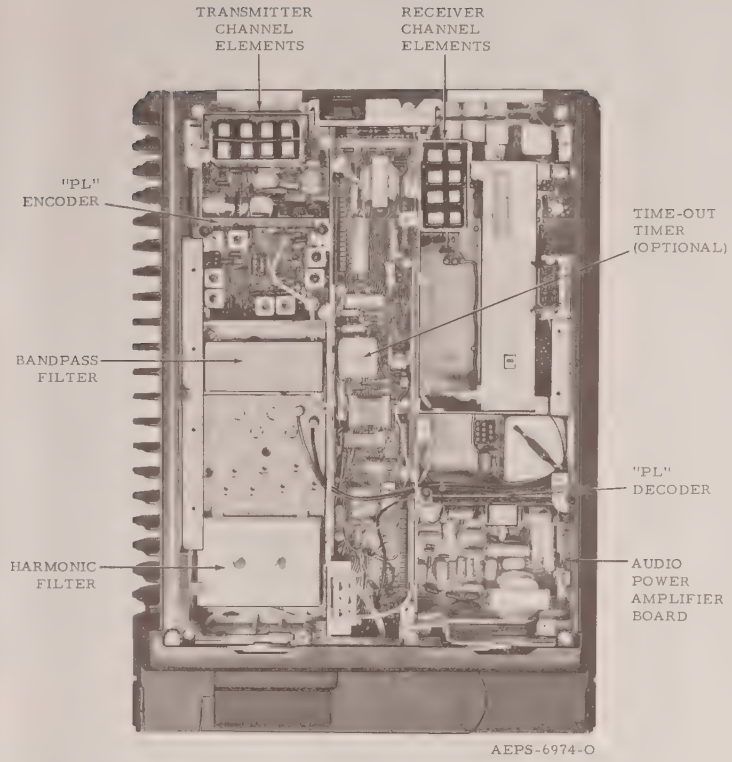
CR1101	48D83461E45	DIODE: SEE NOTE diode, Zener type; nom. 25 V
		LAMP, incandescent: miniature wedge base:
DS1101	65B83554G01	12 V; 0.19 A; type No. 161
DS1102	65B83554G01	12 V; 0.19 A; type No. 161
		CONNECTOR, receptacle:
J1101		c/o (20) 29B84547B01 TERMINALS, pin: male
J1102		c/o (20) 29B84547B01 TERMINALS, pin: male
J1103		c/o (5) 29B84547B01 TERMINALS, pin: male
J1104		c/o (2) 29B84547B01 TERMINALS, pin: male
		RESISTOR:
R1101	6S488090	fixed: 56 ±10%; 2 W
R1102	6S[illegible]291	fixed: 560 ±10%; 1/2 W
R1103	6S5581	fixed: 3.3k ±10%; 1/2 W
R1104	6S5581	fixed: 3.3k ±10%; 1/2 W
R1105	18C84584A02	variable: 25k ±30%; 1/4 W
R1106	18C84584A02	variable: 25k ±30%; 1/4 W
R1107	6S6373	fixed: 150 ±10%; 1/2 W
		SWITCH:
S1101	40C84622B02	slide: dpst; does not include 29S10134A86 LUG, connector, female; 4 required
S1102	40C84301C02	momentary slide; spst
S1103	40C84149C01	rotary; 4-position; non-shorting adjustable limiting stop
	40C84149C02	rotary: 8-position; non-shorting adjustable limiting stop
	40C84149C03	rotary: 12 position; non-shorting
		NON-REFERENCED ITEMS
	TLN4369B	PRINTED CIRCUIT BOARD ASSEMBLY: includes 29B84547B01 TERMINAL, contact; male; 47 required 42C84962C01 RETAINER, connector; 2 required

NOTE:

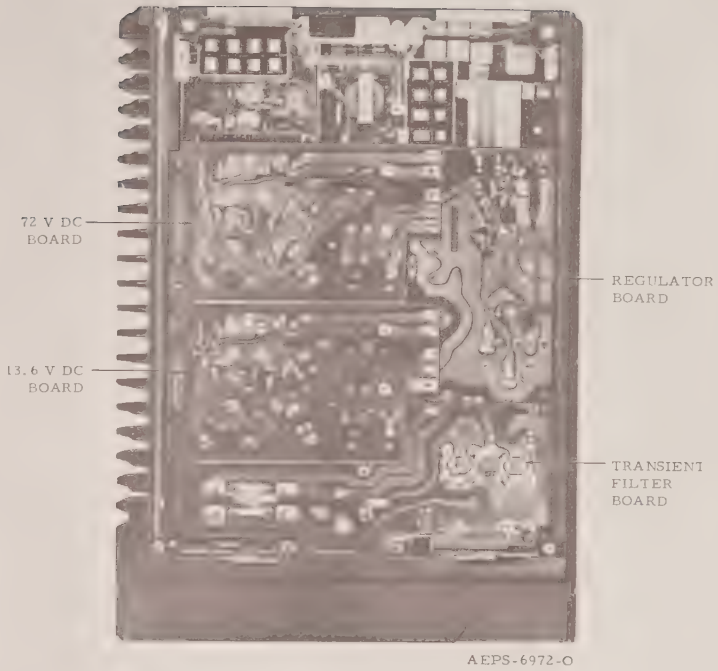
Replacement diodes must be ordered by Motorola part number only for optimum performance.



Radio Set Circuit Board Locations

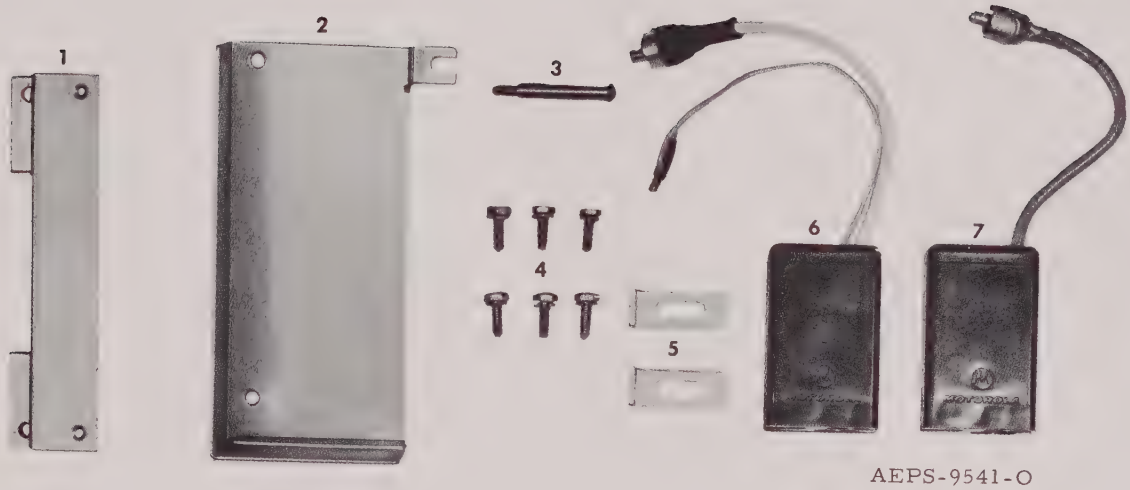


Radio Set Major Component Locations



Power Supply Circuit Board Locations

Figure 5.
Circuit Board and Major Component Location Details



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REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

PARTS LIST

TLN4914A Hardware Kit PL-1906-O

1	7-84707E01	BRACKET, shield mounting
2	26-84710E01	SHIELD, rf
3	3-84709E01	SCREW, guide
4	3-135111	SCREW, tapping (4-40 x 3/8") Phillips hex head; 6 req'd.
5	7-84708E01	BRACKET, retaining; 2 req'd.
6		E701; See Electrical Parts List
7		E702; See Electrical Parts List

1. INTRODUCTION

Three basic maintenance approaches may be used for localizing and repairing trouble in these radio sets.

- Replace the entire radio set with a spare and return the defective radio set to a maintenance shop for repair. This approach is well suited for a user with several identical radios. Operational testing of the radio after replacement is necessary to assure that the radio and its microphone, control head, antenna, cable connections, etc. are operating properly.

- Replace the defective circuit board with a spare and return the defective board to a maintenance shop for repair. This approach is recommended for maintenance facilities that maintain several similar radio sets. Testing must be performed after board replacement to assure that all troubles have been corrected. Realignment must be performed if the board contains alignment adjustments.

NOTE

Check jumper connections on replacement boards to make sure they are the same as originally in the radio.

- Isolate and repair the trouble on the spot. This approach must be used if spares are not available. A few simple tests will isolate the trouble to a specific board. Then detailed troubleshooting of the defective board may be performed.

This section of the manual includes troubleshooting procedures to isolate the defective board. For more extensive troubleshooting, refer to the servicing information for the specific circuit board.

2. TEST EQUIPMENT

a. Portable Test Set

The most important pieces of test equipment required for servicing the "Micor" radio are a Motorola portable test set and Motorola Model TEK-37 or TEK-37A Test Set Adapter or a Motorola TEK-5B or TEK-5C Meter Panel that has been modified by the addition of a TEK-40 Conversion Kit; speedy, efficient, servicing is not possible without this equipment. Therefore, all servicing procedures in this manual assume that the maintenance technician uses these items. The portable test set can also be used for servicing most other Motorola two-way radio equipment; the adapter allows the test set to be used with the 7-pin metering receptacles on this radio equipment.

The radio set contains six metering receptacles in the exciter, power amplifier, power control board, receiver control board, and high end regulator board. A metering receptacle is also provided on the 13.6 V DC, 72 V DC, 110 V DC and rectifier-filter boards, which may or may not be included in every radio set depending on the radio set model. The test set and adapter connect to these metering receptacles to allow rapid checking of over 20 major test points in the radio set for testing, alignment, and the troubleshooting. The portable test set is also used to operate the radio during testing; that is, the transmitter may be keyed, a microphone may be connected to the test set to voice modulate the transmitter signal, and the speaker in the test set may be used for reception of incoming signals.

The test set adapter includes two cables terminated in a red plug and brown plug

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respectively. These plugs mate with the metering receptacles on the radio set. The red "control" plug always connects to the receptacle on the control board. It provides the following functions:

- Push-to-talk input from the test set to the radio which allows transmitter keying from the test set.

IMPORTANT

All portable test sets built before the introduction of "Micor" radio must be modified for compatability with the TEK-37 or TEK-37A Test Set Adapter. These test sets are identified by the stamping on the chassis. Those units stamped SLN6056A-3 or earlier require modification. Those stamped SLN6056A-4 or later do not require modification; they were built to be compatible with the adapter. Once the portable test set is modified, the original metering cable must also be modified to allow continued usage of the test set for servicing other Motorola radio equipment. The SKN6013A Metering Cable, which was supplied with the test set (20-pin connector on one end which plugs into the test set and 11-pin plug on the other), and the SKN6012A Metering Cable, (20-pin connector on one end which plugs into the test set and 12-pin miniature plug on the other end) require modification. The SKN6012B and SKN6013B Metering Cables do not require modification. These are the cables that have been supplied since the introduction of "Micor" radio. If your test set or cable requires modification, refer to the accompanying diagram for instructions.

- Microphone audio input from the test set to the radio which allows voice modulation from the test set.

- Measurement of microphone audio level.

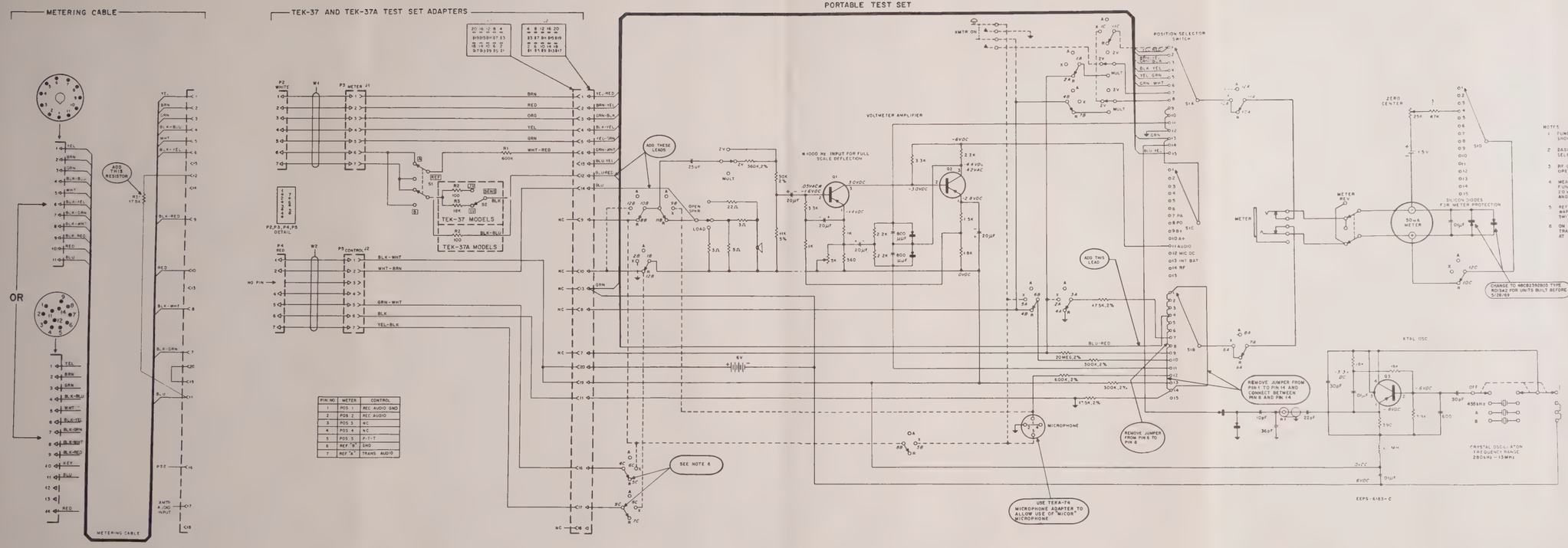
- Speaker audio output from radio to test set which allows measurement and monitoring of received audio signals.

- Measurement of dc input voltage to radio set.

- Measurement of microphone dc voltage.

The white "metering" plug connects to the receptacle on the exciter, power amplifier, power control board, receiver, high end regulator board, 13.6 V DC board, 72 V DC board, 110 V DC board or rectifier-filter board (as required) for measuring the performance at each point critical to performance and alignment. The test set will measure the following circuits:

METERING PLUG CONNECTED TO	SELECTOR SWITCH POSITION	CIRCUIT METERED
Exciter	1	IDC audio
	2	channel element output
	3	modulator output
	4	tripler output
	5	1st doubler output
Power Amplifier	1	exciter output (power amplifier input)
	2	controlled amplifier output
	3	final PA drive #1
	4	final PA drive #2 (high power transmitters only)
	5	final PA current
	6	final PA voltage
Power Control Board	1	forward power (transmitter output power)
	2	reflected power
Receiver RF & IF Board	3	channel element output
	4	discriminator output
	5	i-f signal
High End Regulator Board	1	unregulated A+
	2	regulated A+
	3	switched A+
13.6 V DC Board (if used)	1	primary source (input 13.6 V DC)
	2	drive control
72 V DC Board (if used)	1	primary source (input 72 V DC)
	2	drive control
110 V DC Board (if used)	1	primary source (rectified and filtered 117 V AC)
	2	drive control
Rectifier-Filter Board (if used)	1	Rectified primary voltage
	2	Output ripple



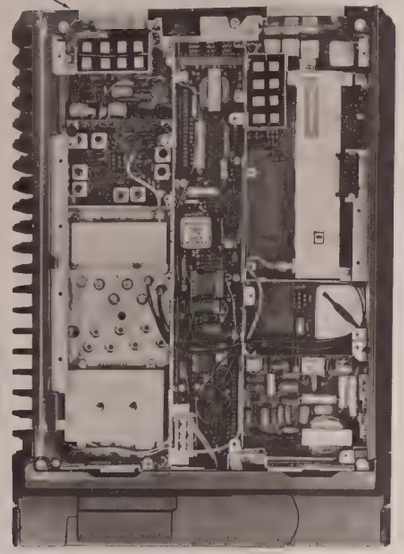
Motorola Portable Test Set
And TEK-37 or TEK-37A Test Set Adapter
Simplified Circuit Diagram
Motorola No. EEPS-6183-C
7/29/74-NPC

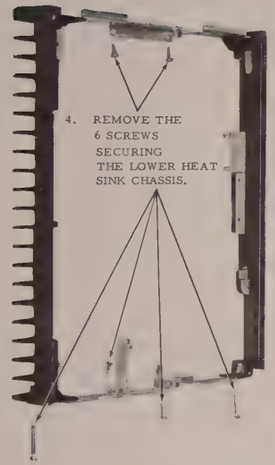
1. REMOVE TOP AND BOTTOM COVERS AND POWER SUPPLY ASSEMBLY. REFER TO THE RESPECTIVE REMOVAL PROCEDURES IN THIS SECTION.

2. REMOVE THE 8 SCREWS SECURING THE HOUSING FRONT PANEL AND PULL PANEL OFF.

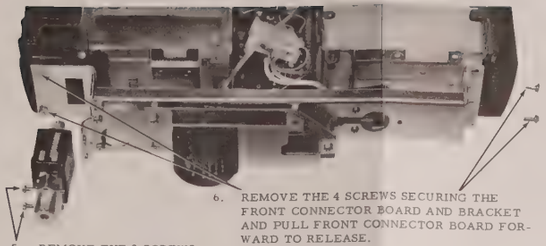
3. REMOVE THE 7 SCREWS SECURING THE HOUSING REAR COVER AND PULL COVER OFF.

NOTE
REMOVAL OF CONTROL BOARD IS NOT RECOMMENDED FOR NORMAL MAINTENANCE PROCEDURES.





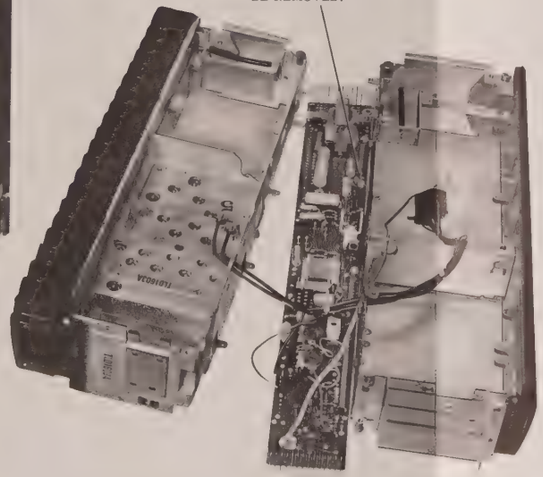
4. REMOVE THE 6 SCREWS SECURING THE LOWER HEAT SINK CHASSIS.

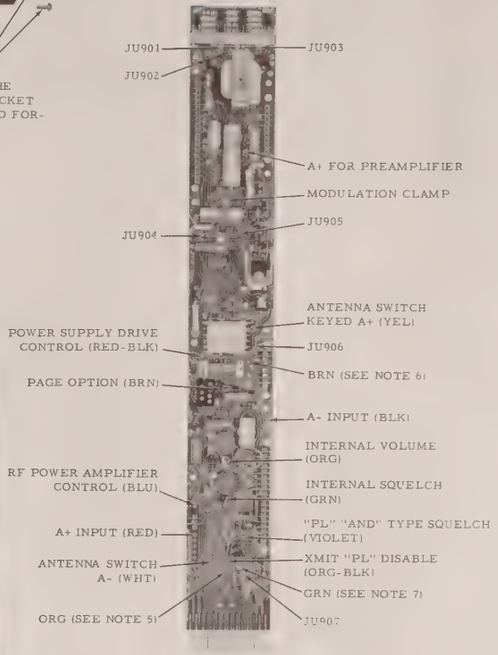


5. REMOVE THE 2 SCREWS SECURING THE ANTENNA SWITCH.

6. REMOVE THE 4 SCREWS SECURING THE FRONT CONNECTOR BOARD AND BRACKET AND PULL FRONT CONNECTOR BOARD FORWARD TO RELEASE.

7. REMOVE THE 8 SCREWS AND ALL THE LEADS SECURING THE CONTROL BOARD. THE CONTROL BOARD MAY NOW BE REMOVED.





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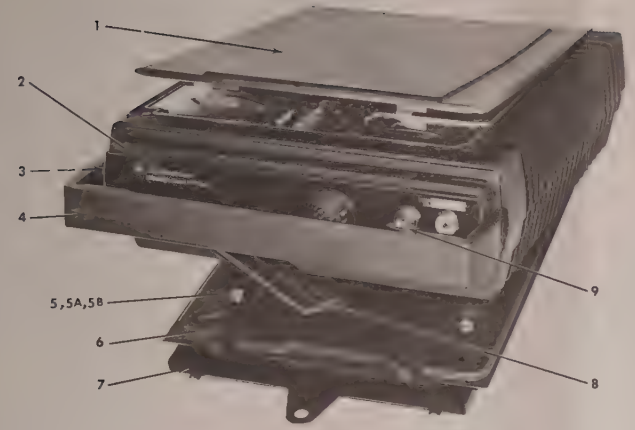
NOTES

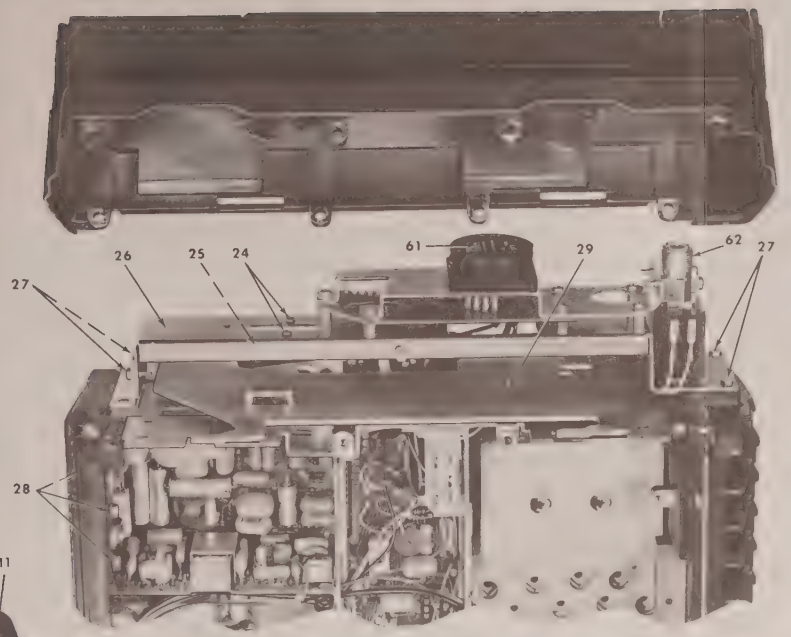
1. JU901, JU902 AND JU903 OUT ON 8-FREQUENCY RADIOS.
2. MICROPHONE AUDIO SENSITIVITY TABLE

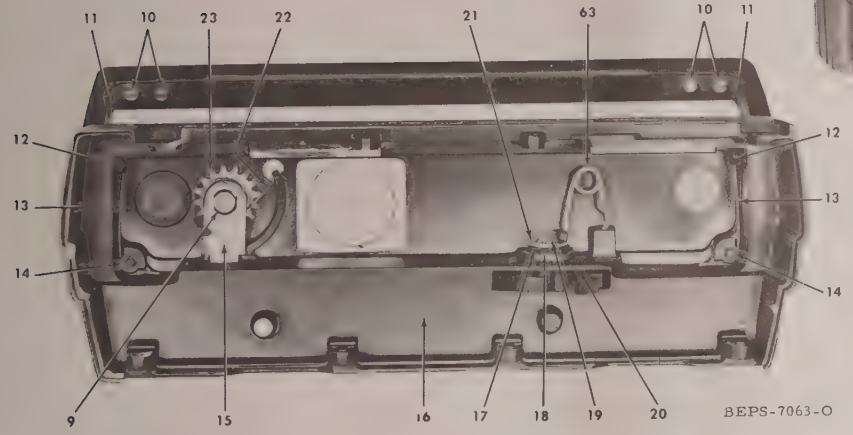
0.30 V FOR ±5.0 kHz DEV.	JU904 OUT & JU905 IN. C408 (SEE EXCITER CIRCUIT BOARD AS SHOWN BY SOLID LINES.
0.22 V FOR ±3.5 kHz DEV.	JU904 OUT & JU905 IN. C408 (SEE EXCITER CIRCUIT BOARD AS SHOWN BY LONG DASHES.
0.165 V FOR ±3.3 kHz DEV.	JU904 IN & JU905 OUT. C408 (SEE EXCITER CIRCUIT BOARD AS SHOWN BY SHORT DASHES.
0.100 V FOR ±2.5 kHz DEV.	JU904 IN & JU905 OUT. C408 (SEE EXCITER CIRCUIT BOARD AS SHOWN BY LONG AND SHORT DASHES.

3. JU906 OUT FOR EXTERNAL EXTENDER SELECT MODE (SEE NOTE 6).
4. JU907 OUT FOR EXTERNAL SQUELCH CONTROL MODE (SEE NOTE 7).
5. FOR EXTERNAL VOLUME CONTROL, PLACE ORG LEAD HERE (MOBILE USE ONLY).
6. FOR EXTERNAL EXTENDER SELECT, PLACE BRN LEAD HERE (MOBILE USE ONLY).
7. FOR EXTERNAL SQUELCH CONTROL, PLACE GRN LEAD HERE (MOBILE USE ONLY).

Figure 15.
Control Board Removal, Replacement and Pin and Jumper Location







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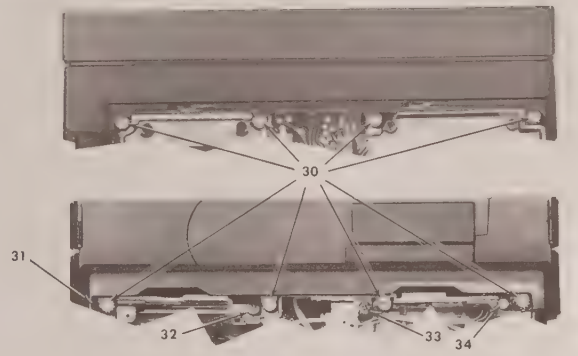
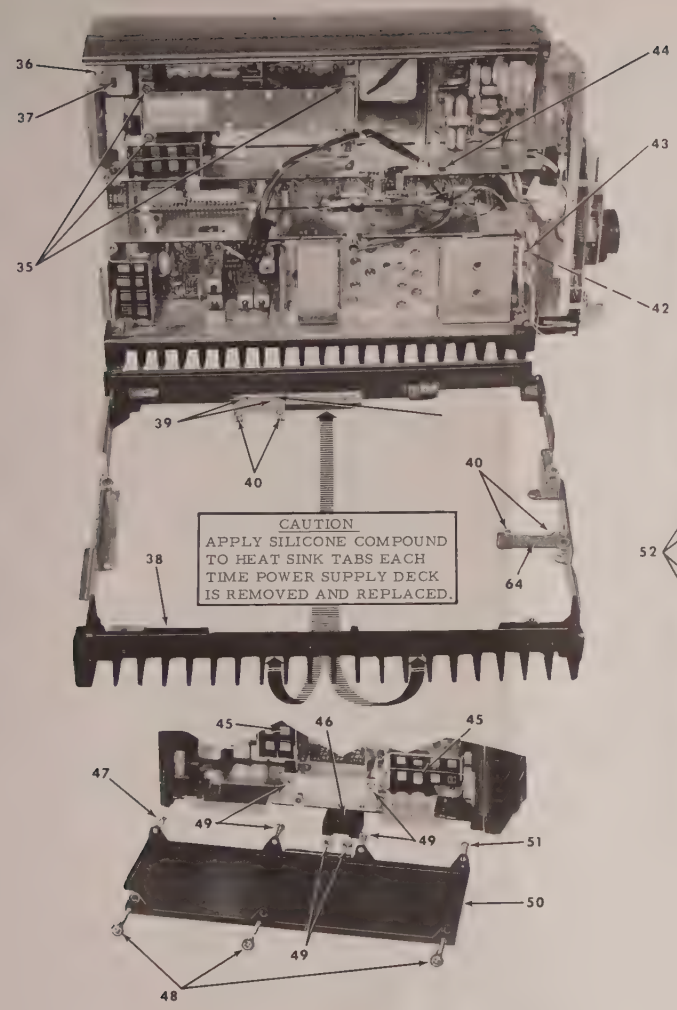
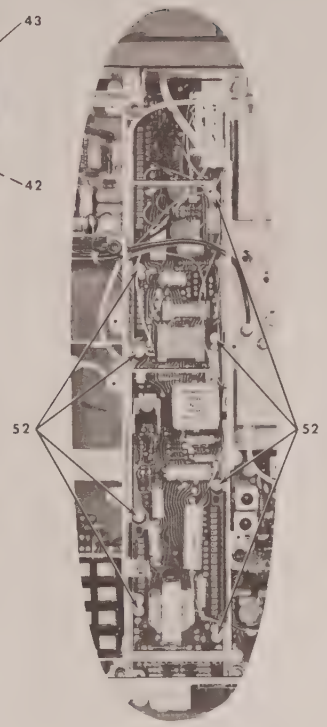


MECHANICAL PARTS LIST

CODE NUMBER	MOTOROLA PART NO.	DESCRIPTION
1	15-84123D01	Cover, top
2	13-84061D01	Escutcheon
3	4-849234	Washer, insulator
4	55-84930C01	Handle
5	2-847043	Nut 1/4-20
5A	3-121856	Screw Machine
5B	4-119331	Washer, split
6	1-80719B77	Cover, Bottom; incl guide rail
7	64-84324D01	Adapter plate, bottom
8	1-80723B64	Latch, incl spring
9	55-84298C01	Assembly, incl key
10	3-122318	Screw, hex head, 6-32 x 5/16
11	1-80723B63	Bracket, pivot
12	22-84019D01	Pin, detent
13	41-84022D01	Spring, detent
14	2-868622	Fastener, Tinnerman
15	45-84026D01	[illegible]
16	64-84931C01	[illegible]
17	4-10059A26	Washer, spring
18	43-84040D01	Bushing, latch
19	3-124890	Screw, machine; 10-32 x 3/8
20	32-84167D01	Shim, latch lever
21	64-84058D01	Plate Latch
22	41-84023D01	Spring, lock
23	4-124837	Washer, lock
24	[illegible]	Screw, tapping, [illegible] incl lock washer
25	80-84177D01	Spark Gap
26	1-80723B65	Chassis, connector
27	3-134169	Screw, tapping, 4-40 x 1/4
28	3-136934	Screw, tapping; 6-32 x 3/8
29	64-84048D01	Plate, locking
30	3-138294	Screw, pan head; 8-32 x 5/8 [illegible] washer
31	3-138529	Screw, tapping; 8-32 x 1-1/8
32	3-138294	Screw, pan head; 8-32 x 5/8 [illegible] lock washer
33	[illegible]	Screw, tapping, [illegible] incl lock washer
34	3-138531	Screw, tapping; 8-32 x 1-5/8

PARTS LIST CONTINUED ON SHEET 2





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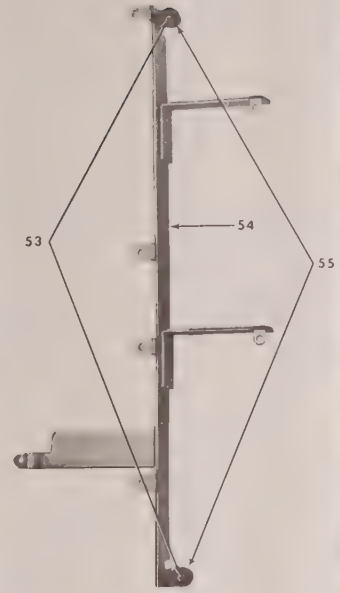
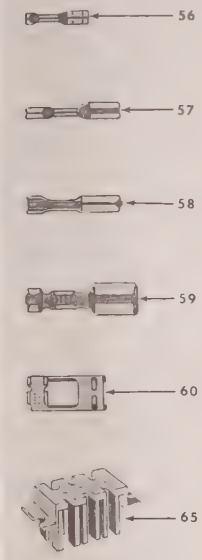


CONNECTOR DETAILS



MECHANICAL PARTS LIST (Cont'd)

CODE NUMBER	MOTOROLA PART NO.	DESCRIPTION
35	3-135715	Screw, tapping: 6-32 x 11/16
36	3-138295	Screw, tapping: 8-32 x 3/8
37	64-84017D01	Plate, adapter
38	1-80723B62	Heat Sink Assembly, lower chassis
[illegible]	3-134212	Screw, tapping: 4-40 x 5/16 incl lock washer
40	3-84196D01	[illegible]
41	7-84663E01	[illegible]
42	3-135502	Screw, cable clamp: 4-4 [illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
46	46-84167B01	Clock, guide
47	[illegible]	[illegible]
48	3-138551	Screw, tapping: 8-32 x 1-3/8 [illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	3-138295	Screw, tapping: 8-32 x 3/8 [illegible]
[illegible]	3-134168	Screw, tapping: 4-40 x 1/4 [illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
61		See Front Connector Board parts list [illegible] Board-power supply]
[illegible]		See Antenna Switch parts list (Transmitter portion of manual)
[illegible]	41-84176D01	Spring, latch lever
64	7-84632E01	BRACKET, receptacle
[illegible]	[illegible]	[illegible]
65	43-84349E01	INSERT, receptacle

MAINTENANCE

When the function selector switch on the test set is in the RCVR position, the transmitter cannot be keyed. This prevents inadvertent keying of the transmitter into a signal generator during receiver testing. The REF A-B switch on the adapter allows two meter references to be used if necessary (such as chassis ground, A- or A+). The earlier Model TEK-37 Test Set Adapter includes a SENS switch which provides two meter sensitivities of 100 millivolts or 1 volt full scale. The Model TEK-37A Test Set Adapter does not have a SENS switch.

Instructions for using the test set to service the "Micor" radio, a list of typical meter readings, and an analysis of abnormal meter readings is given in the "Testing and Troubleshooting" paragraph later in this section of the manual.

b. Other Test Equipment

Refer to the accompanying RECOMMENDED TEST EQUIPMENT TABLE for a list of the test equipment items necessary for complete servicing of the "Micor" radio.

3. TESTING AND TROUBLESHOOTING

CAUTION

Care must be exercised if the radio is to be bench tested by the application of 12-volts directly to the radio transmitter and/or receiver stages. The power supply deck provides overvoltage and surge protection for these circuits; hence, an external power supply feeding the rf circuits directly must be well enough regulated to provide supply voltages that remain below harmful levels. Such a supply must provide a terminal voltage of 13.4 volts under full load with the transmitter keyed, but not exceed 16.5 volts (including transients) when switched to the no load (unkeyed) condition. Most power supplies will not meet this requirement; in fact, some SCR regulated power supplies have transient response that allows the output voltage to momentarily triple when switched from full load to no load. The following bench supplies are approved for testing the "Micor" radio when the power supply deck is bypassed:

Motorola S1303A or S1305A Regulated Power Supply.

CAUTION (CONT'D)

Motorola T1261A Transistorized 24-Volt to 12-Volt Converter driven by a Motorola T1012A Power Supply.

12-Volt automotive battery with a Motorola T1012A Power Supply used as a battery charger.

a. Service Hints

The power supply deck may be removed from the radio and used during servicing by using a Motorola Model TEKA-80 Cable. Loosen the red-capped screws indicated in Figure 16, lift out the power supply boards as a unit and connect the TEKA-80 Cable to the radio set and power supply deck as shown in Figure 1.

NOTE

This procedure is not recommended for 117 V AC radios due to exposed dangerous voltages.

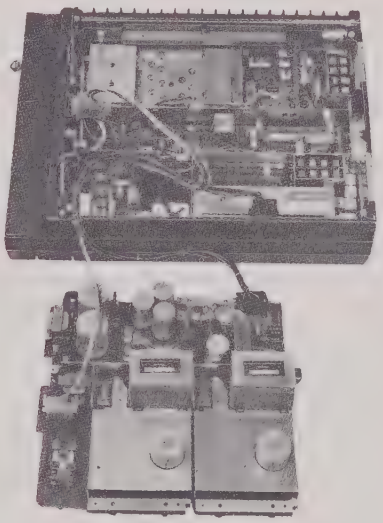


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Figure 1.
Connection of TEKA-80 Cable

CAUTION

1. Do not keep the transmitter continuously keyed for more than 5 minutes. Then unkey for at least 20 minutes. This is necessary since most of the power supply "heat sinking" is lost when the power supply deck is removed from the radio set.
2. When replacing the power supply deck, check the side heat sink surfaces for foreign material and for adequate silicone grease. If necessary, clean the surface and reapply silicone grease to ensure proper heat sink contact.
3. Exercise extreme caution when troubleshooting the 117 V AC power deck. Keep deck inside the radio or turn off the main power when checking components.

For testing radios in a vehicle, the VOLUME and SQUELCH controls may be preset and the radio operated from the portable test set. This allows the technician to make measurements with the radio in actual operating conditions. When the "metering" plug is connected to the receiver metering receptacle, the function selector switch may be placed in either the XMTR or RCVR position. In the RCVR position, the transmitter cannot be keyed. This position should be used when a signal generator is connected to the antenna receptacle for testing. In the XMTR position, the transmitter can be keyed and unkeyed to send and receive test messages. All receiver meter readings are the same as in the RCVR position, except position 4 which reads 0-50 uA instead of 0 center scale.

When the "metering" plug is connected to the power control board and the selector switch is set to position 1, the test set meter measures transmitter output power; a wattmeter is not required. Each radio set is factory calibrated and affixed with a label which shows the test set meter reading which corresponds to the rated power output. This reading is in the range of 22 to 35 uA. The specific value varies from radio to radio depending upon circuit characteristics in the forward power metering circuit.

NOTE

1. There is not conversion from uA to watts at readings other than the calibrated value. Power readings are non-linear and may be used only to show whether power output is high, low, or normal.
2. If the power control board is replaced with a spare or repairs are made in the forward power metering circuit the meter reading must be recalibrated.

TO CALIBRATE FORWARD POWER METER READING

1. Use a wattmeter to measure the transmitter power output.
2. Adjust the POWER SET control for rated transmitter power output.
3. Read the test set meter. This is the reference value (in uA) which corresponds to the rated power output.
4. Fill in this value on the calibration label.

When the "metering" plug is connected to the power control board and the selector switch is in position 2, the test set meter measures reflected power. A dc bias voltage is also present at this point which causes a meter reading with no reflected power. The technician should record this value for reference. The value should be measured with the transmitter terminated in a 50-ohm dummy load (no reflected power). The readings will fall in the 10 to 18 uA range.

If there is an antenna problem, the meter reading will be much higher. Virtually all antenna problems cause a high reflected power which can be checked easily with this feature.

b. Testing

The following procedures outline the step-by-step method of testing the "Micor" radio during troubleshooting. Once the technician becomes familiar with the testing procedures, he will be able to use the troubleshooting charts without referring back to these procedures. The instructions for equipment set-up in one test are continued to the next test without repeating the instructions. Only the difference in test set-up from the previous test are listed.

(1) Power Supply Output Voltage Test

The input to the radio set should be 13.6 to 16 uA (13.6 to 16 volts) as read on position 2 of the test set (meter probe connected to high end regulator board). This may be checked on the portable test set as follows:

(a) Set the controls on the portable test set and test set adapter as follows:

Function selector switch	XMTR
Meter reversing switch	METER REV
Selector switch	position 2
REF switch	A

(b) Connect the white "meter" plug to the high end regulator board meter receptacle.

(c) Turn on the radio set. The test set meter should read 16 uA (16 volts).

(d) Key the transmitter (transmitter output must be terminated in antenna or dummy load). The test set meter should read approximately 13.6 uA (13.6 volts).

(2) Transmitter Power Output Test

The transmitter should provide the rated output of 45 watts. This can be read on the test set on position 1 when connected to the power control board.

The reading should equal that stated on the calibration label. Use the following procedure:

(a) Connect the white "metering" plug to the power control board metering receptacle.

(b) Set the test set selector switch in position 1.

(c) Key the transmitter. The meter should read the value stated on the calibration label (a wattmeter may also be used). The voltage at the cable input should be 13.6 volts when this measurement is made.

(3) Reflected Power Test

The power control board meter 2 reading should not change radically when the transmitter output is terminated in its normal antenna compared to a 50-ohm dummy load. This may be checked as follows:

(a) Change the test set selector switch to position 2.

(b) Terminate the transmitter ouput in a 50-ohm dummy load.

(c) Key the transmitter. The meter should read 10 to 18 uA. (If this value is recorded, skip this step and use the recorded value as reference.)

(d) Disconnect the dummy load and connect the normally used antenna.

(e) Again key the transmitter. The meter reading should not increase radically. An increase up to 10 uA in reading is normal.

(4) Transmitter Deviation Test

A deviation meter should indicate ±5 kHz deviation with full audio modulation. On "Private-Line" models, ±0.5 to 1 kHz deviation should be indicated without voice modulation applied. This may be checked as follows:

(a) Set up a deviation monitor to sample the transmitter output. The antenna of the deviation monitor may be placed near the radio set antenna or dummy load. Sufficient energy will be sampled to obtain the deviation reading.

(b) Key the transmitter and whistle a long, sustained note into the microphone. The deviation meter should read ±5 kHz.

(c) On "Private-Line" models, key the transmitter without an audio input to the microphone. The deviation meter should read ±0.5 to 1 kHz.

(5) Receiver 20 dB Quieting Test

With no signal input and the receiver unsquelched, noise should be heard in the speaker, and read on position 11 of the portable test set (function selector switch in RCVR position.) When a carrier frequency signal is injected, the noise should decrease. No more than 0.5 uV (.25 uV if radio is equipped with rf preamplifier) should be required to decrease the noise 20 dB. This may be checked as follows:

(a) Unsquelch the receiver by turning the SQUELCH control fully counterclockwise. "Private-Line" radios must also be PL disabled by placing the PL monitor switch in the OFF position.

(b) Set the function selector switch of the portable test set to the RCVR position and the selector switch to position 11.

(c) Adjust the VOLUME control for noise in the speaker and a reading on the test set meter. A reading of 2 V ac is a convenient value to use.

(d) Connect an rf signal generator to the antenna input connector and adjust it to the receiver carrier frequency.

(e) Beginning with minimum signal level, increase the signal generator output until the meter 11 reading drops to 1/10 the reference value in step (c), that is, 0.2 V ac. No more than 0.5 microvolt output from the signal generator should be required.

(6) Receiver Audio and Squelch Test

. The receiver should provide 10 watts of audio when the VOLUME control is set at maximum and a strong carrier signal is received that is modulated ±3.3 kHz deviation with a 1000-Hz tone. When the rf input signal is reduced to minimum and the SQUELCH control set at threshold, the speaker should be quieted. Increasing the rf input signal a small amount should again produce the tone in the speaker. On "Private-Line" models, no signals should be heard from the speaker when the PL monitor switch is in the ON position unless the signal has the proper PL tone modulation. These circuits may be checked as follows:

(a) Adjust the signal generator for 1000 uV input to the receiver modulated with 1000 Hz tone for ±3.3 kHz deviation.

(b) Disconnect the red "control" plug of the test set adapter and connect an ac voltmeter to measure the voltage between pins 6 and 7 of the control board metering socket.

(c) Set the VOLUME control to maximum. The ac voltmeter should indicate at least 9 volts rms.

(d) Decrease the signal generator output to minimum.

(e) Set the SQUELCH control at threshold, that is, clockwise until the noise just quiets.

(f) Increase the signal generator output slightly until the tone is again heard in the speaker. No more than 0.25 uV should be required.

(g) On "Private-Line" radios, return the PL monitor switch to the ON position. No tone should be heard on the speaker.

(h) Modulate the rf signal with the proper "Private-Line" tone in addition to the 1000 Hz tone. No more than 0.25 uV should be required from the signal generator for the tone to be heard.

c. Troubleshooting

The following troubleshooting charts, wiring diagram and connector cross reference chart will help localize malfunctions to a specific circuit board or other major unit such as the control head, microphone, antenna, etc. Procedures for performing many of the tests required during troubleshooting are given in the preceding "Testing" paragraphs. Once the malfunction is isolated to a specific circuit board or other major unit, the defective unit may be replaced by a spare -- or detailed troubleshooting of the unit may be performed as described in the unit's section of the manual. RETEST THE RADIO SET AFTER BOARD REPLACEMENT OR REPAIRS.

At the time of installation, a complete set of test set meter readings should be recorded in a table similar to the TEST SET LOG at the back of the manual.

Each time maintenance is performed on the radio, the readings should be compared with the previous set of readings. Any degradation of performance will quickly be noted. Often, a lower reading may indicate and impeding failure and corrective action may be taken before the circuit fails entirely. The minimum values given in the table may be used if no previous readings are available. However, these readings are an absolute minimum for normal operation and are no subsitute for a log of meter readings. A typical radio may have much higher readings and should not be allowed to drop to these minimum values before corrective maintenance is performed. If a log is maintained, even a small drop in meter readings will be noticed. This condition should be interpreted as abnormal operation and corrective action taken (such as realignment) to assure continued peak performance.

4. NETTING

a. General

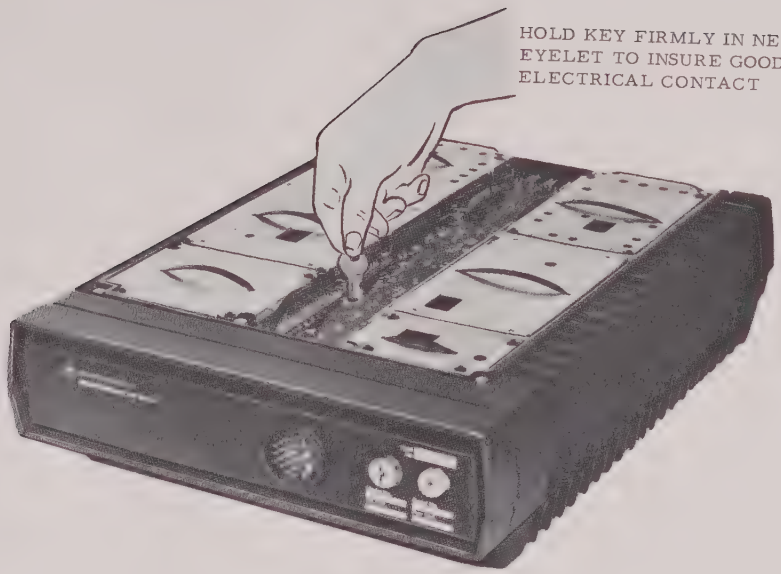
The netting feature provides a quick method of checking and adjusting all radio stations within a network to exactly the same frequency. Utilization of netting, as described in the following paragraph, will insure maximum communication range and clarity.

Netting is accomplished by accurately adjusting the transmitter frequency of a "master" station with calibrated test equipment. The "master" station is then used to transmit an unmodulated carrier signal which is exactly "on-frequency". During this transmission time, all receivers of the other radios within the network can be accurately adjusted to the "master" station frequency. With the receivers now set exactly "on-frequency", they in turn can be used to calibrate their individual transmitters by use of the netting feature. Shorting the NET contacts activates the exciter (except the exciter final amplifier) and the receiver simultaneously. A small amount of the exciter signal leaks into the receiver which provides and "on-frequency" reference to which the transmitter can be adjusted. Upon completing the frequency adjustments, the transmitter and receiver will be "netted" to the "master station and all other stations within the network.

b. Netting Procedure

NOTE

This procedure can be used only when the transmitter and receiver operate on the same frequency.



AEPS-6993-O

Figure 2.
Netting the "Micor" Radio

(1) Connect the white plug of the portable test set to the receiver metering socket.

(2) Set the selector switch to position 4 and the function selector switch to RCVR.

(3) While receiving an unmodulated carrier signal from a "master" station, adjust the receiver channel element warping capacitor for an accurate "on-frequency" reading (exact zero center scale on the test set meter).

(4) Short the NET contacts by inserting and holding the radio key or a similar shorting tool in the eyelet on the control board labeled NET (see Figure 2).

NOTE

If the radio is equipped with AFC, short the AFC DISABLE contact while shorting the NET contacts.

(5) While the NET contacts are shorted, adjust the transmitter channel element warping capacitor for an exact "on-frequency" indication (exact zero center scale on the test set meter).

NOTE

Do not readjust the receiver channel element frequency.

(6) Repeat the procedure for each frequency of operation.

5. REMOVAL AND REPLACEMENT OF CIRCUIT BOARDS AND MAJOR ASSEMBLIES

Figure 3 through 16 illustrates the procedures for removal and replacement of "Micor" radio circuit boards and other major assemblies. The circuit boards must be in place with all mounting screws during testing to provide good rf ground and power connections. Shields must be installed for operation of the radio. In "Private-Line" models the PL encoder must be installed for transmitter operation and the PL decoder must be installed for receiver operation unless the carrier squelch jumpers are connected on the exciter and receiver audio and squelch board.

TEST SET LOG

SELECTOR SWITCH POSITION	METER REV. SWITCH	REF. SWITCH	FUNCTION SELECTOR	FUNCTION METERED	MINIMUM READING	LOG OF ACTUAL READINGS				
						DATE	DATE	DATE	DATE	NOTES
CONTROL BOARD (red "Control" plug connected to control board)										
10	OFF	A or B	XMTR or RCVR	A+	13 V (0-30 V scale)					
11	OFF	A or B	RCVR	speaker audio	NOTE 1					
			XMTR	mic. audio	NOTE 1					
12	OFF	A or B	XMTR or RCVR	mic. dc	6 V (0-15 V scale) NOTE 5					
13	OFF	-	-	test set internal battery	6 V (0-15 V scale)					
RECEIVER (white "metering" plug connected to receiver)										
3* 3	METER REV	A or B	RCVR or XMTR	channel element	15 uA					
3* 4	METER REV	A or B	RCVR	discri-minator	0 ±2 uA Max. NOTE 2					
3* 5	METER REV	A or B	RCVR or XMTR	i-f	1 uA NOTE 2					
EXCITER (white "metering" plug connected to exciter)										
4* 1	OFF	A	XMTR	"IDC"	12 uA NOTE 3					
4* 2	OFF	A	XMTR	channel element	20 uA					
4* 3	OFF	A	XMTR	modulator	20 uA					
4* 4	OFF	A	XMTR	tripler	20 uA					
4* 5	OFF	A	XMTR	1st dblr	15 uA					
POWER AMPLIFIER (white "metering" plug connected to power amplifier)										
3* 1	METER REV	A	XMTR	exciter output	20 uA					
3* 2	METER REV	A	XMTR	driver input	25 uA					
3* 3	METER REV	A	XMTR	driver output	25 uA					
3* 5	METER REV	B	XMTR	final current	MAX. READING 33 uA					
3* 6	METER REV	B	XMTR	final voltage	12 V (0-30 V scale)					
POWER CONTROL BOARD (white "metering" plug connected to power control board)										
5* 1	METER REV	A or B	XMTR	output power	see cali-bration label					
5* 2	OFF	A or B	XMTR	reflected power	10-18 uA max. NOTE 4					
5* 5	METER REV	B	XMTR	control current	50 uA max.					Maximum when properly tuned
POWER SUPPLY HIGH END REGULATOR (white "metering" plug connected to high end regulator board)										
5* 1	METER REV	A or B	XMTR	A+ unreg-ulated	13 uA NOTE 6					
5* 2	METER REV	A or B	XMTR	A+ regulated	13 uA NOTE 6					
5* 3	METER REV	A or B	XMTR	A+ keyed	11 uA NOTE 6					
POWER SUPPLY +13.6 V DC BOARD (white "metering" plug connected to 13.6 V DC board)										
3* 1	METER REV	A or B	XMTR	primary input	25 uA NOTE 6					
3* 2	OFF	A or B	XMTR	drive control	10 uA NOTE 6					
POWER SUPPLY 72 V DC BOARD (white "metering" plug connected to 72 V DC board)										
3* 1	METER REV	A or B	XMTR	primary input	25 uA NOTE 6					
3* 2	OFF	A or B	XMTR	drive control	10 uA NOTE 6					

NOTES:

1. VARIES WITH AUDIO LEVEL.
2. NO SIGNAL INPUT CONDITION.
3. 3 VOLTS 1000-Hz AUDIO APPLIED (MIC SENSITIVITY JUMPERS SET FOR 0.36 V FOR 3.5 kHz).
4. WITH 50-OHM LOAD.
5. KEYED FROM MIC 9 V IF KEYED FROM EXMTR ON BUTTON.
6. IN TRANSMIT WITH NOMINAL LINE VOLTAGE (13.6 OR 72 V DC).

*INDICATES SELECTOR SWITCH POSITION ON TEK-5 METER PANEL, THAT HAS BEEN MODIFIED BY A TEK-40 CONVERSION KIT.

RF PREAMPLIFIER ALIGNMENT

STEP	ADJUST	SELECTOR SWITCH POSITION	OSC. & METER REV. SWITCH	PROCEDURE
1				If radio is equipped with optional preamplifier, disconnect and bypass the preamplifier. Align the receiver then reconnect the preamplifier.
2	L3, L2, L1	5	METER REV.	Adjust L3, L2, and L1 in that order for maximum test set meter indication. Repeat.
3				Tune L2 for maximum quieting.

EPS-7375-O

RECEIVER ALIGNMENT PROCEDURE

STEP	ADJUST	SELECTOR SWITCH POSITION	OSC. & METER REV. SWITCH	STAGE & PROCEDURE
1	L108, L109	3	METER REV.	CHANNEL ELEMENT OUTPUT (3RD HARMONIC) - Adjust L108 and L109 for maximum test set meter indication. On multi-frequency radios make this adjustment with frequency selector switch in F1 position.
2	L107	11 4	A or B (Test Set must be equipped with 11,7 MHz crystal in corresponding socket).	DISCRIMINATOR - Unsquelch the radio set by turning the squelch control on the control board fully counterclockwise. "Private-Line" radios must also be PL disabled by placing the PL monitor switch on the control head in the OFF position. Note test set meter indication in position 11 (multiplier switch in 2 V AC position). Insert 11,7 MHz injection probe of test set into L106 opening of receiver shield being careful not to contact circuit board. Insert probe into hole far enough to obtain reading 1/10 of that noted at beginning of this step (signal is "sprayed" into radio). Adjust L107 for 0 center reading on top scale with selector switch of test set in position 4. Adjustment is critical and should be exactly on 0. Remove probe.
3	L110, L111	5	METER REV.	MULTIPLIER - Connect signal generator to antenna input and apply a carrier frequency signal. Adjust L110 and L111 for maximum meter indication. If two peaks are observed, use peak with slugs farthest from circuit board. If a meter 5 indication cannot be obtained, connect center conductor of signal generator cable directly to the mixer gate (Q101).
4	L101, L102, L103, L104, L105, L106	5	METER REV.	RF PRESELECTOR AND MIXER - Turn out slugs L101 thru L105 until tip of each tuning screw extends approx. 1/4 inch beyond spring (parts list code 8). Connect signal generator to antenna input and apply carrier frequency signal. Tune L101 thru L105 for peak on meter position 5. Turn slugs L103, L104, and L105 in one turn. Peak L106 thru L101, in that order, on meter position 5. Decrease signal generator output as necessary to maintain indication between 10 and 25 uA.
5	L108, L110, L111	5	METER REV.	Adjust signal generator output for 25 uA meter indication. Detune L108 until meter indication decreases to 15 uA. Repeak L110 and L111 for maximum meter indication. Repeat entire step.
6	L108, L109	3	METER REV.	Repeak L108 and L109 for maximum meter indication.
7	L101, L102, L103, L104, L105	5 11	METER REV. OFF	Repeak L101 through L105 for maximum meter indication. Repeat. Peak L103 thru L105 for minimum indication on meter 11 (maximum quieting).
8	F1, F2, F3, F4	5 4	METER REV.	ON-FREQUENCY ADJUSTMENT - Disconnect signal generator and transmit carrier signal from transmitter normally received. If transmitter is known to be on frequency, test set meter position 5 should indicate rise when transmitter is keyed (if necessary connect antenna). Check test set position 4 reading with transmitter keyed. 0 indicates on-frequency condition. Adjust F1, F2, F3 and F4 receiver warp capacitors for exact 0 reading in corresponding frequency selector switch positions. DO NOT READJUST L108 OR L109 AFTER THESE ADJUSTMENTS ARE MADE. If radio is equipped with AFC, short the AFC DISABLE contact while adjusting F1, F2, F3 and F4.
9	-	-	-	Perform 20 dB quieting sensitivity measurement as check of alignment.

EPS-7376-O

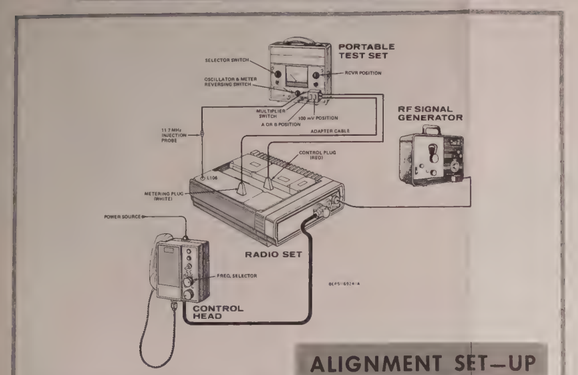
NOTES:

Approved bench power supplies:
"Motorola" S1303A or S1305A Regulated Power Supply
"Motorola" T1261A Transistorized 24-Volt to 12-Volt Converter driven by "Motorola" T1012A Power Supply.
12-Volt Automotive battery with "Motorola" T1012A Power Supply used as a battery charger.
"Motorola" T1015A 64-Volt Power Supply.

EPS-7377-O

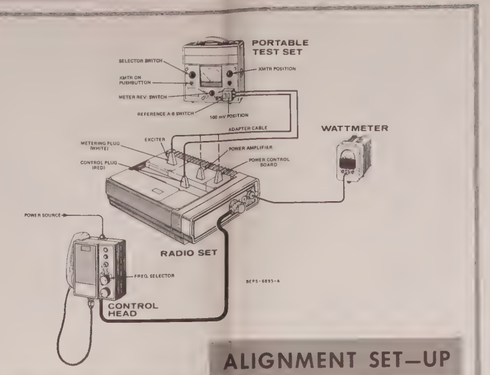
PEPS-6953-C

RECEIVER ADJUSTMENTS



ALIGNMENT SET—UP

TRANSMITTER ADJUSTMENTS



ALIGNMENT SET—UP

ADJUSTMENT LOCATIONS

FREQUENCY CALCULATIONS

Where:

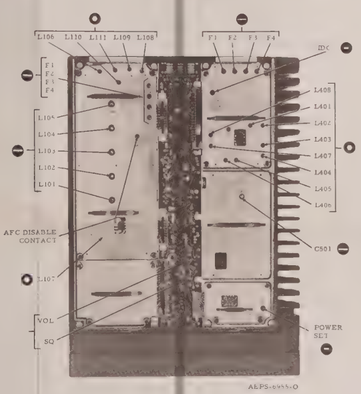
f_o = channel element frequency

f_c = carrier frequency

150.8-174 MHz

$$f_o = \frac{f_c - 11.7\ MHz}{9}$$

EPS-7378-O



AEPS-6955-O

20 DB QUIETING SENSITIVITY CHECK

1. Unsquelch the radio set by turning the SQ (squelch) control on the control board fully counterclockwise. "Private-Line" radios must also be PL disabled by placing the PL monitor switch in the OFF position.
2. Connect the red "control" plug of the adapter cable to the control receptacle on the radio set.
3. Set the multiplier switch on the test set in the 2 V AC position.
4. Adjust the VOL (volume) control on the control board until 2 volts is obtained on meter position 11. To silence the speaker during the test, set the speaker switch of the test set in the LOAD position and disconnect the speaker.
5. Connect the signal generator to the radio set antenna receptacle and adjust it to the receiver frequency. Set the rf output to minimum.
6. Increase the signal generator output until the meter reading drops to 0,2 volt in meter position 11 (place the multiplier switch in the 0,2 V AC position). The generator output level now indicates the 20 dB quieting sensitivity and should be 0,5 microvolt, or less (0,25 microvolt with preamplifier).

EPS-7379-O

OSCILLATOR FREQUENCY ADJUSTMENT

1. Set up the test equipment as shown for frequency measurement. Disconnect the audio oscillator from the portable test set.
2. Key the transmitter with no modulation. Key the transmitter with the XMTR ON pushbutton on the portable test set rather than with the handset. On "Private-Line" radios, turn the PL tone OFF.
3. Adjust the channel element warp capacitor for the selected channel to the exact desired frequency. Adjust the warp capacitor which corresponds to the frequency selector switch setting on the control head: repeat for each frequency.

"IDC" ADJUSTMENT PROCEDURE

1. Set up the test equipment as shown for deviation measurement. Connect the audio oscillator to the portable test set.
2. Set the audio oscillator to 1000 Hz and 3 volts. On "Private-Line" models, replace the "Vibrasender" resonant reed.
3. Key the transmitter and adjust the IDC control for ±5 kHz deviation.
4. Reduce the tone oscillator output to 0,45 volts. Essentially full deviation should still be indicated.

FREQUENCY CALCULATIONS

Where:

f_o = channel element frequency

f_c = carrier frequency

$$f_o = \frac{f_c}{12} \qquad f_c = 12\ f_o$$

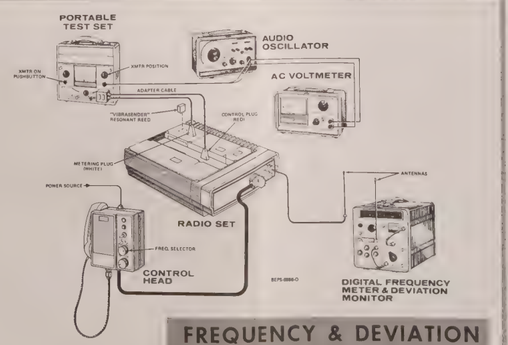
EPS-7380-O

EXCERPTS FROM FCC REGULATIONS

FCC Regulations state that:

1. Radio transmitters may be tuned or adjusted only by persons holding a first or second class commercial radiotelephone operator's license or by personnel working directly under their immediate supervision.
2. The power input to the final radio frequency stage shall not exceed the maximum figure specified on the current station authorization. This power input shall be measured and the results recorded:
   a. When the transmitter is initially installed.
   b. When any change is made in the transmitter which may increase the power input.
   c. At intervals not to exceed one year.
3. Frequency and deviation of a transmitter must be checked:
   a. When it is initally installed.
   b. When any change is made in the transmitter which may affect the carrier frequency or modulation characteristics.
   c. At intervals not to exceed one year.

EPS-7381-O



FREQUENCY & DEVIATION MEASUREMENT SET—UP

TRANSMITTER ALIGNMENT PROCEDURE

STEP	ADJUST	METERING PLUG LOCATION	TEST SET SELECTOR SWITCH POSITION	OSC. & METER REV. AND ADAPTER CABLE REF. SWITCHES	STAGE AND PROCEDURE
1					SET-UP - Connect the test equipment and set switches as shown. Key the transmitter with the XMTR ON pushbutton on the portable test set.
2	POWER SET				OUTPUT - Turn the POWER SET control fully counterclockwise.
3	FREQUENCY SWITCH	EXCITER	2	OFF REF A	CHANNEL ELEMENT - Select the desired frequency. Key the transmitter. The test set meter 2 should indicate at least 10 uA.
4	ALL EXCITER COILS	EXCITER	3	OFF REF A	PRE-ALIGNMENT - If the exciter is completely untuned and shows no meter 3 reading, set cores of all tuning coils to the top of their coil forms (away from circuit board) and proceed with step 5. If the exciter shows meter 3 readings, set cores of all tuning coils except L401 and L402 to the top of their coilforms (away from the circuit board). Tune L401 and L402 in that order for maximum meter indication. Go to step 7 of the procedure.
5	L401	EXCITER	2	OFF REF A	MODULATOR OUTPUT - Tune L401 for minimum meter reading.
6	L401, L402	EXCITER	3	OFF REF A	MODULATOR OUTPUT - Tune L402, then L401 for peak meter reading.
7	L403	EXCITER	3	OFF REF A	TRIPLER OUTPUT - Tune L403 for minimum meter reading.
8	L403, L404	EXCITER	4	OFF REF A	TRIPLER OUTPUT - Tune L404 and then L403 for peak meter reading.
9	L405	EXCITER	4	OFF REF A	FIRST DOUBLER OUTPUT - Tune L405 for minimum meter reading.
10	L405, L406	EXCITER	5	OFF REF A	FIRST DOUBLER OUTPUT - Tune L406 and then L405 for peak meter reading.
11	L407	EXCITER	5	OFF REF A	EXCITER OUTPUT - Tune L407 for minimum meter reading.
12	L407, L408	PA	1	METER REV. REF A	EXCITER OUTPUT - Move the metering plug to the PA. Tune L408 and then L407 for peak meter reading.
13					Repeat steps 6, 8 and 10.
14					Align the power amplifier.
15					For complete power amplifier tune-up, proceed with step 16. To check alignment, move metering plug to power control board and go to step 20.
16	C501				PA PRE-ALIGNMENT - Set capacitor C501 fully clockwise.
17	POWER SET C501	POWER CONTROL BOARD	5	METER REV. REF B	OUTPUT - Move metering plug to the power control board. Gradually rotate the POWER SET control until an initial meter 5 reading is observed. Do not readjust POWER SET control. If this indication is less than 50 uA (full scale), proceed with step 18. If this indication is greater than 50 uA, tune C501 for an on-scale reading.
18	POWER SET	POWER CONTROL BOARD	Wattmeter or 1	METER REV. REF A	OUTPUT - Without exceeding rated power output of 45 watts on wattmeter or calibration label value on meter 1, adjust the POWER SET control for rated power or until no further increase in power output is observed. Then adjust the POWER SET control counterclockwise for an approximate 5 W reduction on the wattmeter or 3 uA reduction from meter 1 reading.
19	C501	POWER CONTROL BOARD	5	METER REV. REF B	PA DRIVER OUTPUT - Tune C501 for minimum meter 5 reading.
20	POWER SET	POWER CONTROL BOARD	Wattmeter or 1 5	METER REV. REF A METER REV. REF B	OUTPUT - Adjust the POWER SET control for rated power output and repeat step 19 (if rated power cannot be attained, repeat steps 18 and 19). For continuous duty operation, adjust POWER SET control for 40 W. (Canadian units set for 30 W.) Check meter 5 reading, it must not exceed 50 uA.
21		PA	5	METER REV. REF B	FINAL COLLECTOR CURRENT - Move the metering plug to the PA. Measure the final collector current (Ic). Ic in amperes is the meter 5 reading (0-50 uA) x 2×10^5.
22		PA	6	METER REV. REF B	FINAL COLLECTOR VOLTAGE - Measure the final collector voltage (Vc). Vc is the meter 6 reading (0-30 volt scale).
23					Determine final input power (Pin). Pin equals Vc x Ic. Pin should be less than 90 watts.

EPS-7382-O

SERVICE SHEET

MOTOROLA

150.8–174 MHz RAILROAD "MICOR"®

FM Two-Way Radio Set

MODELS

R43RTE1190AA	R43RTA1190AA	R43RTH1190AA
R43RTE3190AA	R43RTA3190AA	R43RTH3190AA

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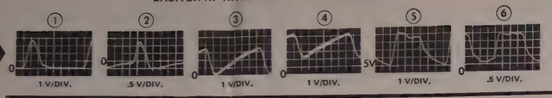
68P81102E81-F

ALL RF WAVEFORMS TAKEN UNDER FOLLOWING CONDITIONS:

1. MOUNTAIN WAVEFORMS SIMILAR TO THOSE SHOWN. OSCILLOSCOPE MUST HAVE 8+ MHZ BANDWIDTH "SWANN-R.S.T." ML AMPLIFIER.
2. VERTICAL SENSITIVITY SHOWN UNDER EACH WAVEFORM.
3. LESS THAN 50 MV DC.
4. HORIZONTAL DEFLECTION = 10 nanosec/DIV.
5. TRIGGER ON 5 MV P-P.
6. NO MODULATION. REMOVE "VIBRASENDER" REED. REED IN "PL" RADIO.

EPS-6779-O

EXCITER RF WAVEFORMS (12.5-14.5 MHz)

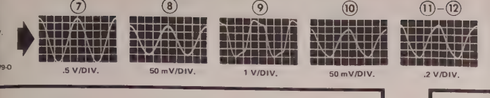


ALL AUDIO WAVEFORMS TAKEN UNDER FOLLOWING CONDITIONS:

1. VERTICAL SENSITIVITY SHOWN UNDER EACH WAVEFORM.
2. VERTICAL INPUT = AC.
3. HORIZONTAL DEFLECTION = 0.2 msec/DIV.
4. 1000 Hz 1 VOLT rms (2.8 V P-P) AUDIO AT MICROPHONE INPUT.
5. "DC" POT SET FOR ±5 kHz DEVIATION.

EPS-6779-O

EXCITER AUDIO WAVEFORMS



OSCILLOSCOPE WAVEFORMS MEASURED UNDER FOLLOWING CONDITIONS:

1. WAVEFORMS SHOWN USING 100-Hz "VIBRASENDER" RESONANT REED.
2. VERTICAL SENSITIVITY SHOWN UNDER EACH WAVEFORM.
3. HORIZONTAL DEFLECTION = 5 msec/DIV.
4. ALL WAVEFORMS MEASURED IN RESPECT TO CHASSIS GROUND.

EPS-6781-O

"PL" ENCODER WAVEFORMS

GENERAL

1. UNLESS OTHERWISE STATED
   CAPACITOR VALUES ARE IN PICOFARADS
2. UNLESS OTHERWISE STATED, VOLTAGE MEASUREMENTS ARE FOR DC VOLTAGES MEASURED WITH AN 11 MEGOHM INPUT RESISTANCE VOLTMETER IN RESPECT TO CHASSIS GROUND.
3. COMPONENT REFERENCES OUTLINED BY A RECTANGLE (EXCEPT FOR THE PIN NUMBERS ON THE CONTROL BOARD) INDICATE LABELLING ON THE RADIO SET.

EPS-6820-O

FCC LICENSE DESIGNATION

NO OF CHANNELS	990% STABILITY	990% STABILITY
1-4	CC3149	CC3149
1-8	CC3150	CC3150

EPS-6819-A

EXCITER

401 TRANSMITTER FREQUENCY CALCULATION

$$f_c = \frac{f_e}{12} - 1.7\text{M}$$

WHERE

f_c = CHANNEL ELEMENT FREQUENCY

f_e = CARRIER FREQUENCY

402 VOLTAGE MEASURED ACROSS R428 WHERE ONLY ONE DC VOLTAGE READING IS SHOWN. USE ONLY A HIGH IMPEDANCE 11 MEGOHM VOLTMETER. WHERE TWO READINGS ARE SHOWN THE TOP VALUE IS MEASURED WITH A 20,000 OHM PER VOLT METER. THE BOTTOM VALUE IS MEASURED WITH A 20,000 OHM PER VOLT VOLTMETER.

403 UNLESS OTHERWISE STATED, VOLTAGES AND WAVEFORMS MEASURED IN RESPECT TO CHASSIS GROUND.

404 VOLTAGES WILL VARY SLIGHTLY IF +8 V VOLT SOURCE IS ABOVE OR BELOW NOMINAL VALUE. NORMAL VARIATION, FROM RADIO TO RADIO IS ±1 TO 10 % VOLTS REGULATED.

405 UNLESS OTHERWISE STATED CAPACITOR VALUES ARE IN PICOFARADS.

407 SEE AUDIO SENSITIVITY TABLE

EPS-6780-O

AUDIO SENSITIVITY

DESIRED MIC AUDIO SENSITIVITY	REQUIRED CONNECTIONS
0.36 V FOR ±3 kHz DEVIATION	A/804-OUT & J/905 IN CA08 AS SHOWN IN SOLID LINES
0.22 V FOR ±3 kHz DEVIATION	A/804-OUT & J/905 IN CA08 AS SHOWN IN DASHED LINES
3.100 V FOR ±3 kHz DEVIATION	A/804 "A & J/905 OUT CA08 AS SHOWN IN SOLID LINES
3.100 V FOR ±3 kHz DEVIATION	A/804 "A & J/905 OUT CA08 AS SHOWN IN DASHED LINES

EPS-7100-O

CONTROL BOARD

901 A/807, J/802 & A/803 OUT ON 8-FREQUENCY RADIOS.

902 SEE AUDIO SENSITIVITY TABLE

903 J/906 OUT FOR EXTERNAL EXTENDER SELECT (MOBILE)

904 A/807 OUT FOR EXTERNAL SQUELCH CONTROL (MOBILE)

905 ORG LEAD TO PIN 16 FOR EXTERNAL VOLUME CONTROL (MOBILE); OR TO PIN 15 FOR INTERNAL VOLUME CONTROL

906 GRN LEAD TO PIN 12 FOR EXTERNAL SQUELCH CONTROL (MOBILE); OR TO PIN 14 FOR INTERNAL SQUELCH CONTROL

907 BRN LEAD TO PIN 7 FOR EXTERNAL EXTENDER SELECT (MOBILE); OR TO PIN 6 FOR PAGE

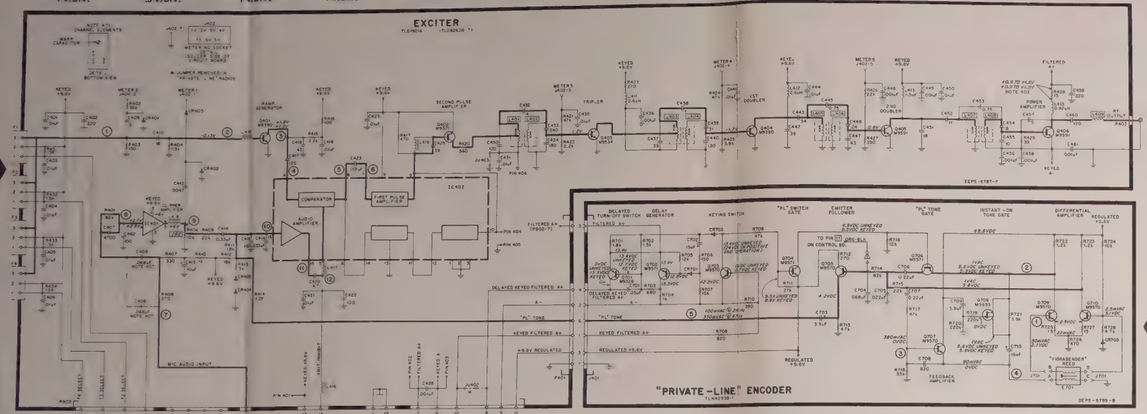
908 ALL VOLTAGES MEASURED WITH RESPECT TO CHASSIS GROUND.

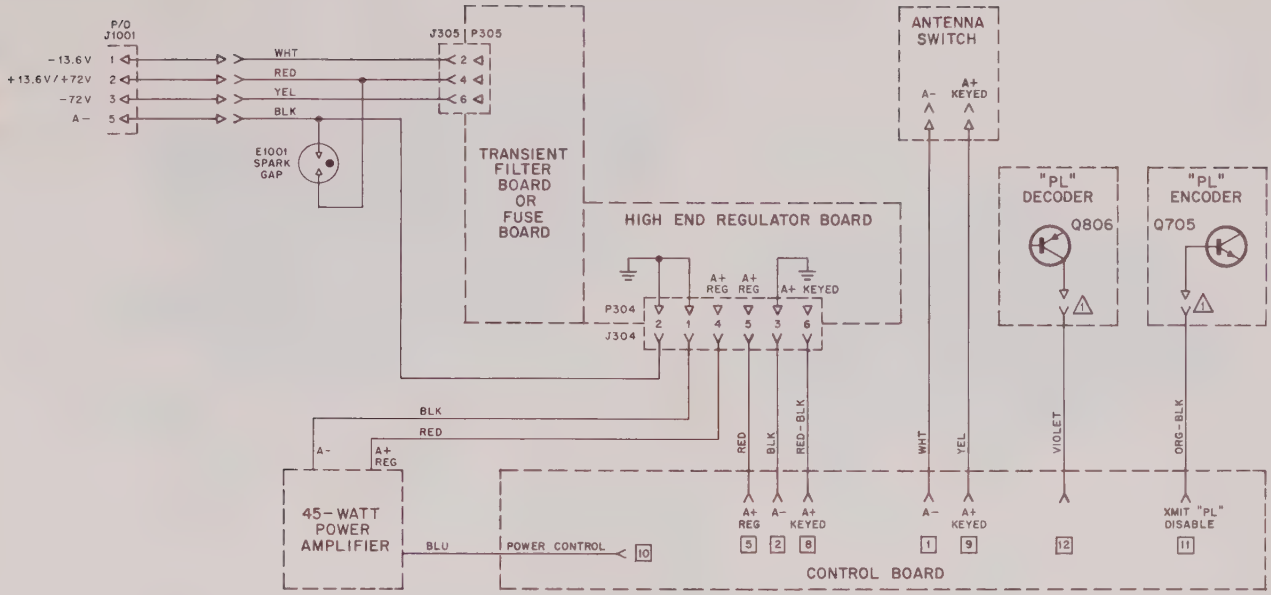
909 UNLESS OTHERWISE STATED, CAPACITOR VALUES ARE IN PICOFARADS.

910 VOLTAGES SHOWN AT BASE AND COLLECTOR OF Q807 ARE WITH THE TRANSMITTER KEYED

EPS-6958-O

EXCITER





CEPS-6911-O

CONNECTOR CROSS REFERENCE CHART

REFERENCE SYMBOL	CONNECT(S)
P1	AAR Standard Installation to Front Connector Board
P2, P3	Antenna Switch to RF Preamplifier (if used) or, to RF Preselector
P4, P5	Antenna Switch to Power Control Board
P201, J201	Receiver Audio & Squelch Board to PL Decoder Board (if used)
P301, J301	Transient Filter Board (if used) to High End Regulator Board -- or -- the Fuse Board (if used) to High End Regulator Board
P302, J302	13.6 V DC Board (if used) to High End Regulator Board
P303, J303	72 V DC Board (if used) to High End Regulator Board
P304, J304	High End Regulator Board to various points in the radio set
P305, J305	Transient Filter Board (if used) to Front Connector Board or, Fuse Board (if used) to Front Connector Board
P401, J401	Exciter Board to PL Encoder Board (if used)
P402	Exciter Board to Band Pass Filter (Z501)
J501	45-Watt Power Amplifier Board to Band Pass Filter (Z501)
J502	45-Watt Power Amplifier Board to Harmonic Filter (Z502)
J601	Power Control Board to Harmonic Filter (Z502)
J602	Power Control Board to Antenna Switch
P901, J901	Control Board to Front Connector Board
P902, J902	Exciter Board to Control Board
P903, J903	Receiver Audio & Squelch Board to Control Board
P904, J904	Receiver RF & IF Board to Control Board
J905	8-Frequency Channel Element Board (when used) to Control Board
P906, J906	Power Control Board to Control Board and 45-Watt Power Amplifier
P908	Time-Out Timer (if used) to Control Board
J1001	Front Connector Board to AAR Standard Installation

EPS-7118-O

Wiring Diagram & Connector Cross Reference Chart
Motorola No. CEPS-6911-O
7/29/74-NPC

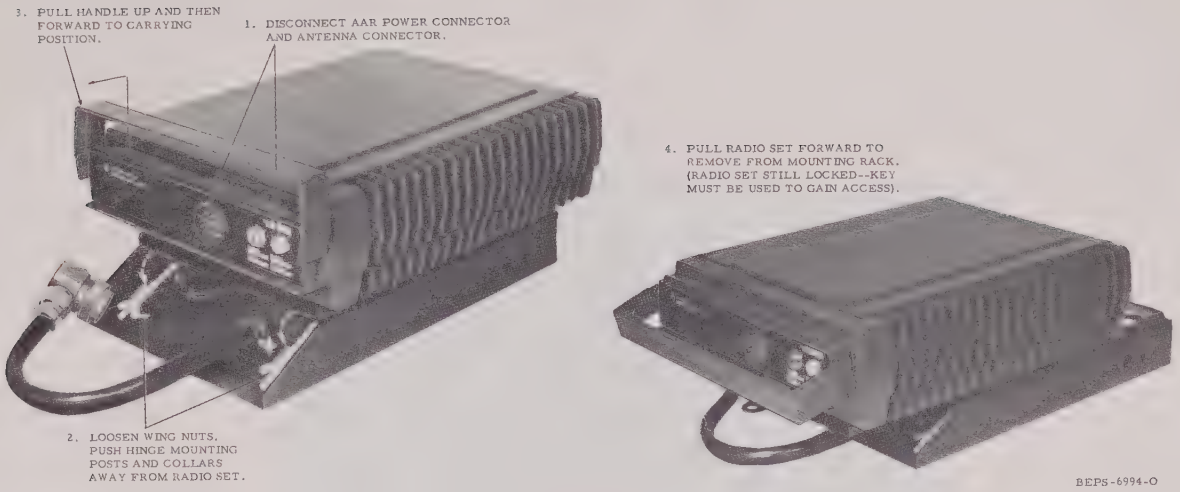
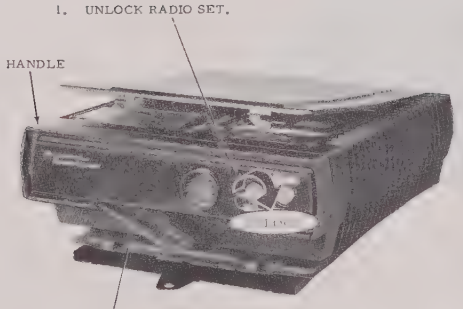


Figure 3.
Removal of Radio Set

ACCESS



2. PULL LATCH LEVER FORWARD TO RELEASE TOP AND BOTTOM COVERS (TOP COVER WILL "POP" UP). LIFT THE RADIO SET FORWARD AND UP TO REMOVE FROM THE BOTTOM COVER.

3. PUSH LATCH LEVER INTO A NORMALLY CLOSED POSITION.

REPLACEMENT

1. PULL LATCH LEVER FORWARD.
2. POSITION RADIO SET SO THAT GUIDE BLOCK AT THE REAR OF THE SET IS IN THE CENTER GROVE OF THE BOTTOM COVER. PUSH RADIO SET BACK AND LOWER UNTIL PROPERLY SEATED ON THE BOTTOM COVER.

3. HOOK TOP COVER OVER BACK LIP ON THE RADIO SET.
4. PRESS DOWN FIRMLY ON TOP COVER AND SIMULTANEOUSLY PUSH FORWARD ON THE LATCH LEVER TO SEAT AND SECURE TOP COVER.

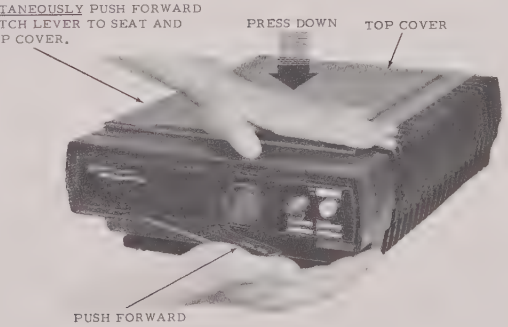


Figure 4.
Access and Replacement of Radio Set

PEPS-14993-A

EXCITER RF WAVEFORMS (12.5-14.5 MHz)

ALL RF WAVEFORMS TAKEN UNDER FOLLOWING CONDITIONS

1. TO OBTAIN WAVEFORMS SIMILAR TO THOSE SHOWN, OSCILLOSCOPE MUST HAVE AT LEAST 50 MHz BANDWIDTH 7 nanosec RISE TIME AMPLIFIER
2. VERTICAL SENSITIVITY SHOWN UNDER EACH WAVEFORM
3. VERTICAL INPUT - DC
4. HORIZONTAL DEFLECTION = 10 nanosec DIV
5. TRANSMITTER KEYED
6. NO MODULATION REMOVE "VIBRASENDER" REED (REED IN "PL" RADIO)

EPS-6778-O

① 1 V/DIV. ② .5 V/DIV. ③ 1 V/DIV. ④ 1 V/DIV. ⑤ 1 V/DIV. ⑥ .5 V/DIV.

EXCITER AUDIO WAVEFORMS

ALL AUDIO WAVEFORMS TAKEN UNDER FOLLOWING CONDITIONS

1. VERTICAL SENSITIVITY SHOWN UNDER EACH WAVEFORM.
2. VERTICAL INPUT = AC.
3. HORIZONTAL DEFLECTION = 0.2 msec/DIV.
4. 1000-Hz 1-VOLT rms (2.8 V P-P) AUDIO AT MICROPHONE INPUT.
5. "IDC" POT SET FOR +5 kHz DEVIATION.

EPS-6779-O

⑦ .5 V/DIV. ⑧ 50 mV/DIV. ⑨ 1 V/DIV. ⑩ 50 mV/DIV. ⑪-⑫ .2 V/DIV.

"PL" ENCODER WAVEFORMS

OSCILLOSCOPE WAVEFORMS MEASURED UNDER FOLLOWING CONDITIONS:

1. WAVEFORMS SHOWN USING 100-Hz "VIBRASENDER" RESONANT REED.
2. VERTICAL SENSITIVITY SHOWN UNDER EACH WAVEFORM.
3. HORIZONTAL DEFLECTION = 5 msec/DIV.
4. ALL WAVEFORMS MEASURED IN RESPECT TO CHASSIS GROUND.

EPS-6781-O

① 50 mV/DIV. ② .5 V/DIV. ③ .2 V/DIV. ④ 50 mV/DIV. ⑤ .2 V/DIV.

GENERAL

1. UNLESS OTHERWISE STATED CAPACITOR VALUES ARE IN PICOFARADS
2. UNLESS OTHERWISE STATED, VOLTAGE MEASUREMENTS ARE FOR DC VOLTAGES MEASURED WITH AN 11 MEGOHM INPUT RESISTANCE VOLTMETER IN RESPECT TO CHASSIS GROUND
3. COMPONENT REFERENCES OUTLINED BY A RECTANGLE (EXCEPT FOR THE PIN NUMBERS ON THE CONTROL BOARD) INDICATE LABELLING ON THE RADIO SET

EPS-6820-O

FCC LICENSE DESIGNATION

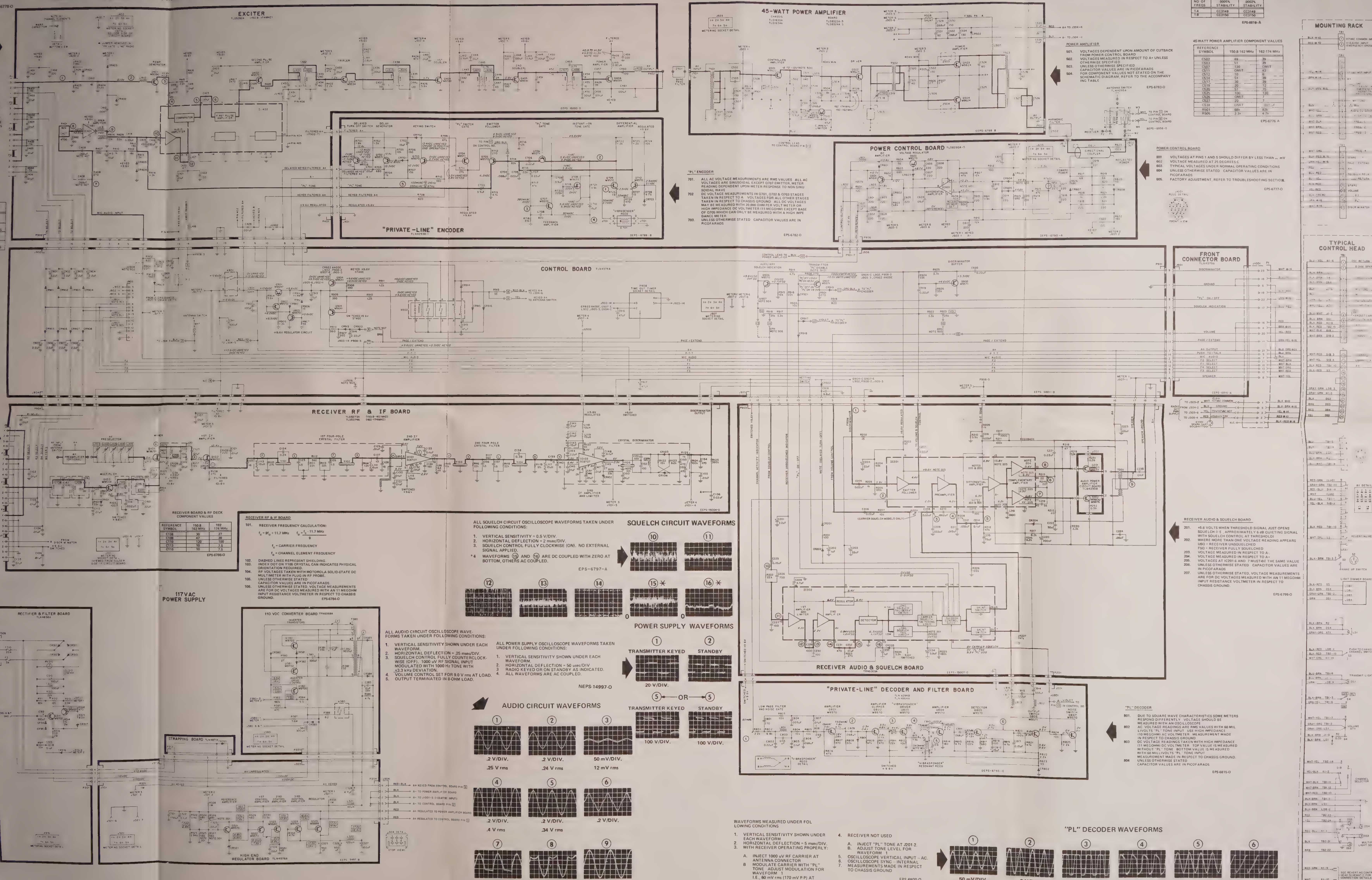
NO OF FREQS	.0005% STABILITY	.0002% STABILITY
1-4	CC3149	CC3149
1-8	CC3150	CC3150

EPS-6819-A

45-WATT POWER AMPLIFIER COMPONENT VALUES

REFERENCE SYMBOL	150.8-162 MHz	162-174 MHz
C502	49	39
C503	51	39
C507	130	OMIT
C511	OMIT	43
C512	10	6
C514	51	39
C517	30	39
C519	20	12
C520	51	75
C525	100	130
C526	OMIT	7
C527	20	7
C538	OMIT	.001 uF
R501	68k	82k
R505	3.3k	4.7k

EPS-6776-A



EXCITER

401 TRANSMITTER FREQUENCY CALCULATION

WHERE

f_o = CHANNEL ELEMENT FREQUENCY

f_c = CARRIER FREQUENCY

402 VOLTAGE MEASURED ACROSS R428

403 WHERE ONLY ONE DC VOLTAGE READING IS SHOWN, USE ONLY A HIGH IMPEDANCE (11 MEGOHM) VOLTMETER. WHERE TWO READINGS ARE SHOWN THE TOP VALUE IS MEASURED WITH A HIGH IMPEDANCE VOLT METER. THE BOTTOM VALUE IS MEASURED WITH A 20,000 OHM PER VOLT MULTIMETER

404 UNLESS OTHERWISE STATED VOLTAGES AND WAVEFORMS MEASURED IN RESPECT TO CHASSIS GROUND

405 VOLTAGES WILL VARY SLIGHTLY IF +9.6 VOLT SOURCE IS ABOVE OR BELOW NOMINAL VALUE NORMAL VARIATION FROM RADIO TO RADIO IS 9.1 TO 10.1 VOLTS REGULATED

406 UNLESS OTHERWISE STATED CAPACITOR VALUES ARE IN PICOFARADS

407 SEE AUDIO SENSITIVITY TABLE

EPS-6780-O

AUDIO SENSITIVITY

DESIRED MIC AUDIO SENSITIVITY	REQUIRED CONNECTIONS
0.36 V FOR ±3.5 kHz DEVIATION	JU904 OUT & JU905 IN C408 AS SHOWN IN SOLID LINES
0.22 V FOR ±3.5 kHz DEVIATION	JU904 OUT & JU905 IN C408 AS SHOWN IN DASHED LINES
0.165 V FOR ±3.3 kHz DEVIATION	JU904 IN & JU905 OUT C408 AS SHOWN IN SOLID LINES
0.100 V FOR ±3.3 kHz DEVIATION	JU904 IN & JU905 OUT C408 AS SHOWN IN DASHED LINES

EPS 7100-O

CONTROL BOARD

901 JU901 JU902 & JU903 OUT ON 8-FREQUENCY RADIOS

902 SEE AUDIO SENSITIVITY TABLE

903 JU906 OUT FOR EXTERNAL EXTENDER SELECT MOBILE

904 JU907 OUT FOR EXTERNAL SQUELCH CONTROL MOBILE

905 ORG LEAD TO PIN 16 FOR EXTERNAL VOLUME CONTROL (MOBILE) OR TO PIN 15 FOR INTERNAL VOLUME CONTROL

906 GRN LEAD TO PIN 13 FOR EXTERNAL SQUELCH CONTROL (MOBILE) OR TO PIN 14 FOR INTERNAL SQUELCH CONTROL

907 BRN LEAD TO PIN 7 FOR EXTERNAL EXTENDER SELECT (MOBILE) OR TO PIN 6 FOR PAGE

908 ALL VOLTAGES MEASURED WITH RESPECT TO CHASSIS GROUND

909 UNLESS OTHERWISE STATED CAPACITOR VALUES ARE IN PICOFARADS

910 VOLTAGES SHOWN AT BASE AND COLLECTOR OF Q907 ARE WITH THE TRANSMITTER KEYED

EPS-6858-O

POWER AMPLIFIER

501. VOLTAGES DEPENDENT UPON AMOUNT OF CUTBACK FROM POWER CONTROL BOARD
502. VOLTAGES MEASURED IN RESPECT TO A+ UNLESS OTHERWISE SPECIFIED
503. UNLESS OTHERWISE SPECIFIED CAPACITOR VALUES ARE IN PICOFARADS
504. FOR COMPONENT VALUES NOT STATED ON THE SCHEMATIC DIAGRAM, REFER TO THE ACCOMPANYING TABLE

EPS-6783-O

"PL" ENCODER

701. ALL AC VOLTAGE MEASUREMENTS ARE RMS VALUES. ALL AC VOLTAGES ARE SINUSOIDAL EXCEPT Q707 EMITTER. METER READING DEPENDENT UPON METER RESPONSE TO NON SINUSOIDAL WAVE
702. DC VOLTAGE MEASUREMENTS IN Q701, Q702 & Q703 STAGES TAKEN IN RESPECT TO A-. VOLTAGES FOR ALL OTHER STAGES TAKEN IN RESPECT TO CHASSIS GROUND. ALL DC VOLTAGES MAY BE MEASURED WITH 20,000 OHM PER VOLT METER OR HIGH IMPEDANCE DC VOLTMETER (11 MEGOHM) EXCEPT BASE OF Q705 WHICH CAN ONLY BE MEASURED WITH A HIGH IMPEDANCE METER
703. UNLESS OTHERWISE STATED CAPACITOR VALUES ARE IN PICOFARADS

EPS-6782-O

POWER CONTROL BOARD

601 VOLTAGES AT PINS 1 AND 5 SHOULD DIFFER BY LESS THAN ... mV
602 VOLTAGE MEASURED AT 25 DEGREES C
603. TYPICAL VOLTAGES UNDER NORMAL OPERATING CONDITIONS
604 UNLESS OTHERWISE STATED CAPACITOR VALUES ARE IN PICOFARADS
605. FACTORY ADJUSTMENT, REFER TO TROUBLESHOOTING SECTION.

EPS-6777-O

RECEIVER RF VOLTAGE TABLE

SET RF INPUT AT ANT TO OBTAIN (NOTE 104)	AT TEST POINT	RF INPUT SHOULD BE (MAY VARY APPROX. 2 TO 1)
300 mV	A	13 mV
	B	13 mV
	C	8 mV
50 mV	D	3 mV
	E	4 mV
	F	5 mV
	G	5 mV
	H	13 mV
	I	50 uV
	J	10 uV
	K	14 uV
	L	20 uV
	M	21 uV
	N	72 uV

EPS-6785-A

RECEIVER BOARD & RF DECK COMPONENT VALUES

REFERENCE SYMBOL	150.8 162 MHz	162 174 MHz
C108	30	27
C109	47	39
C110	120	100
C113	10	7.5
C118	10	7.5

EPS-6786-O

RECEIVER RF & IF BOARD

101. RECEIVER FREQUENCY CALCULATION:

$f_c = 9f_o + 11.7\text{ MHz} \qquad f_o = \frac{f_c - 11.7\text{ MHz}}{9}$

f_c = CARRIER FREQUENCY

f_o = CHANNEL ELEMENT FREQUENCY

102. DASHED LINES REPRESENT SHIELDING.
103. INDEX DOT ON Y105 CRYSTAL CAN INDICATES PHYSICAL ORIENTATION REQUIRED.
104. RF VOLTAGES TAKEN WITH MOTOROLA SOLID-STATE DC MULTIMETER WITH PLUG-IN RF PROBE.
105. UNLESS OTHERWISE STATED CAPACITOR VALUES ARE IN PICOFARADS.
106. UNLESS OTHERWISE STATED, VOLTAGE MEASUREMENTS ARE FOR DC VOLTAGES MEASURED WITH AN 11 MEGOHM INPUT RESISTANCE VOLTMETER IN RESPECT TO CHASSIS GROUND.

EPS-6784-O

SQUELCH CIRCUIT WAVEFORMS

ALL SQUELCH CIRCUIT OSCILLOSCOPE WAVEFORMS TAKEN UNDER FOLLOWING CONDITIONS:

1. VERTICAL SENSITIVITY = 0.5 V/DIV.
2. HORIZONTAL DEFLECTION = 2 msec/DIV.
3. SQUELCH CONTROL FULLY CLOCKWISE (ON). NO EXTERNAL SIGNAL APPLIED.

*4 WAVEFORMS ⑮ AND ⑯ ARE DC COUPLED WITH ZERO AT BOTTOM, OTHERS AC COUPLED.

EPS-6797-A

⑩ ⑪ ⑫ ⑬ ⑭ ⑮* ⑯*

RECEIVER AUDIO & SQUELCH BOARD

201. +5.6 VOLTS WHEN THRESHOLD SIGNAL JUST OPENS SQUELCH (I.E., APPROXIMATELY 6 dB QUIETING SIGNAL WITH SQUELCH CONTROL AT THRESHOLD)
202. WHERE MORE THAN ONE VOLTAGE READING APPEARS USO = RECEIVER UNSQUELCHED FSO = RECEIVER FULLY SQUELCHED
203. VOLTAGE MEASURED IN RESPECT TO A-.
204. VOLTAGE MEASURED IN RESPECT TO A+
205. VOLTAGES AT IC201-6 AND 7 MUST BE THE SAME VALUE
206. UNLESS OTHERWISE STATED CAPACITOR VALUES ARE IN PICOFARADS
207. UNLESS OTHERWISE STATED, VOLTAGE MEASUREMENTS ARE FOR DC VOLTAGES MEASURED WITH AN 11 MEGOHM INPUT RESISTANCE VOLTMETER IN RESPECT TO CHASSIS GROUND.

EPS-6799-O

117 VAC POWER SUPPLY

POWER SUPPLY

301 REFER TO POWER SUPPLY MAINTENANCE SECTION IN INSTRUCTION MANUAL FOR COMPONENT VALUE SELECTION

302 VOLTAGE MEASUREMENTS ARE FOR DC VOLTAGES MEASURED WITH AN 11 MEGOHM INPUT RESISTANCE VOLTMETER WITH RESPECT TO CHASSIS GROUND

VOLTAGE MEASURED IN

—— V = STANDBY MODE

—— V = TRANSMIT MODE

303 UNLESS OTHERWISE STATED CAPACITOR VALUES ARE IN PICOFARADS

304 MODEL COMPLEMENT

DESCRIPTION	ITEM	TLN4576A	TLN4838A	TLN4871A	TPN6068A
117 V AC POWER SUPPLY		X	X		X
13.6 V DC POWER (EMERG)		X	X	X	

NEPS 14998-O

POWER SUPPLY WAVEFORMS

ALL POWER SUPPLY OSCILLOSCOPE WAVEFORMS TAKEN UNDER FOLLOWING CONDITIONS:

1. VERTICAL SENSITIVITY SHOWN UNDER EACH WAVEFORM.
2. HORIZONTAL DEFLECTION = 50 usec/DIV
3. RADIO KEYED OR ON STANDBY AS INDICATED.
4. ALL WAVEFORMS ARE AC COUPLED.

① TRANSMITTER KEYED ② STANDBY — 20 V/DIV.

⑤ —OR— ⑤ TRANSMITTER KEYED 100 V/DIV. STANDBY 100 V/DIV.

AUDIO CIRCUIT WAVEFORMS

ALL AUDIO CIRCUIT OSCILLOSCOPE WAVEFORMS TAKEN UNDER FOLLOWING CONDITIONS:

1. VERTICAL SENSITIVITY SHOWN UNDER EACH WAVEFORM.
2. HORIZONTAL DEFLECTION = .25 msec/DIV.
3. SQUELCH CONTROL FULLY COUNTERCLOCKWISE (OFF). 1000 uV RF SIGNAL INPUT MODULATED WITH 1000 Hz TONE WITH ±3.3 kHz DEVIATION.
4. VOLUME CONTROL SET FOR 9.0 V rms AT LOAD.
5. OUTPUT TERMINATED IN 8-OHM LOAD.

NEPS-14997-O

① .2 V/DIV. .25 V rms ② .2 V/DIV. .24 V rms ③ 50 mV/DIV. 12 mV rms

④ .2 V/DIV. .4 V rms ⑤ .2 V/DIV. .34 V rms ⑥ .2 V/DIV.

⑦ .5 V/DIV. ⑧ .5 V/DIV. ⑨ .5 V/DIV.

"PL" DECODER

801. DUE TO SQUARE WAVE CHARACTERISTICS SOME METERS RESPOND DIFFERENTLY. VOLTAGE SHOULD BE MEASURED WITH AN OSCILLOSCOPE
802 AC VOLTAGE READINGS ARE RMS VALUES WITH 60 MILLIVOLTS "PL" TONE INPUT. USE HIGH IMPEDANCE (10 MEGOHM) AC VOLTMETER. MEASUREMENT MADE IN RESPECT TO CHASSIS GROUND
803 DC VOLTAGE READINGS TAKEN WITH HIGH IMPEDANCE (11 MEGOHM) DC VOLTMETER. TOP VALUE IS MEASURED WITHOUT "PL" TONE. BOTTOM VALUE IS MEASURED WITH 60 MILLIVOLTS "PL" TONE INPUT. MEASUREMENT MADE IN RESPECT TO CHASSIS GROUND.
804 UNLESS OTHERWISE STATED CAPACITOR VALUES ARE IN PICOFARADS

EPS-6815-O

"PL" DECODER WAVEFORMS

WAVEFORMS MEASURED UNDER FOLLOWING CONDITIONS

1. VERTICAL SENSITIVITY SHOWN UNDER EACH WAVEFORM
2. HORIZONTAL DEFLECTION = 5 msec/DIV.
3. WITH RECEIVER OPERATING PROPERLY:
   A. INJECT 1000 uV RF CARRIER AT ANTENNA CONNECTOR
   B. MODULATE CARRIER WITH "PL" TONE. ADJUST MODULATION FOR WAVEFORM 1 I.E., 60 mV rms (170 mV P-P) AT J201 2.
4. RECEIVER NOT USED
   A. INJECT "PL" TONE AT J201-2.
   B. ADJUST TONE LEVEL FOR WAVEFORM 1
5. OSCILLOSCOPE VERTICAL INPUT -- AC.
6. OSCILLOSCOPE SYNC -- INTERNAL
7. MEASUREMENTS MADE IN RESPECT TO CHASSIS GROUND

EPS 6800-O

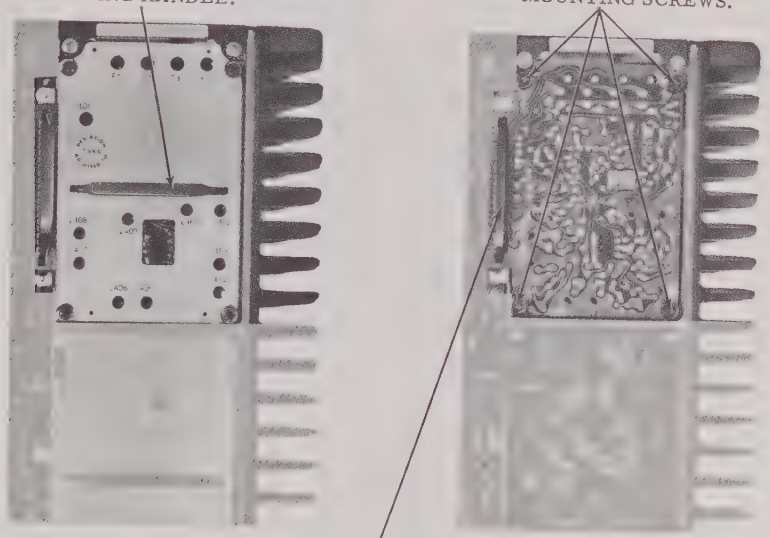
① 50 mV/DIV. ② .2 V/DIV. ③ 2 V/DIV. ④ .2 V/DIV. ⑤ 50 mV/DIV. ⑥ 1 V/DIV.

1. TURN OFF POWER TO RADIO

2. UNPLUG COAXIAL CONNECTOR (ON COMPONENT SIDE OF BOARD). REMOVAL OF THE 72 V DC POWER SUPPLY MAY BE NECESSARY.

3. REMOVE EXCITER SHIELD BY LIFTING HANDLE.

4. LOOSEN FOUR MOUNTING SCREWS.



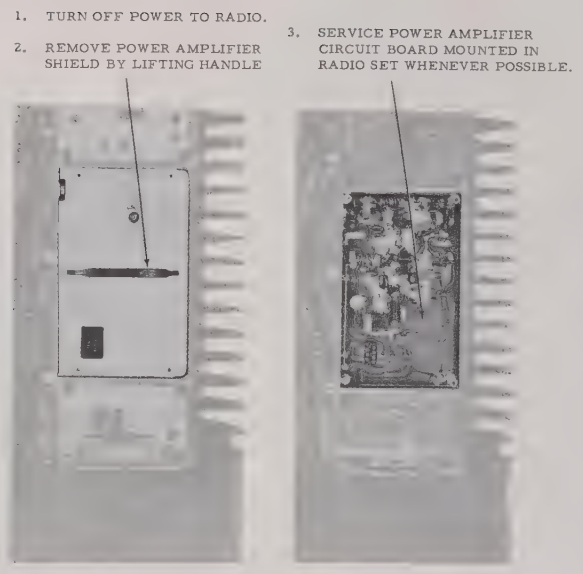
AEPS-6995-O

5. LIFT OUT EXCITER CIRCUIT BOARD BY HANDLE.

NOTE: ("PL" MODELS ONLY)

WHEN REPLACING EXCITER CIRCUIT BOARD, CHECK ALIGNMENT OF PIN CONNECTION WITH "PL" ENCODER.

Figure 6.
Exciter Board Removal and Replacement



NOTE
REMOVAL OF POWER AMPLIFIER CIRCUIT BOARD IS NOT RECOMMENDED UNLESS ABSOLUTELY NECESSARY. REMOVAL INFORMATION IS GIVEN IN POWER AMPLIFIER INSTRUCTION SECTION.

Figure 7.
Power Amplifier Servicing

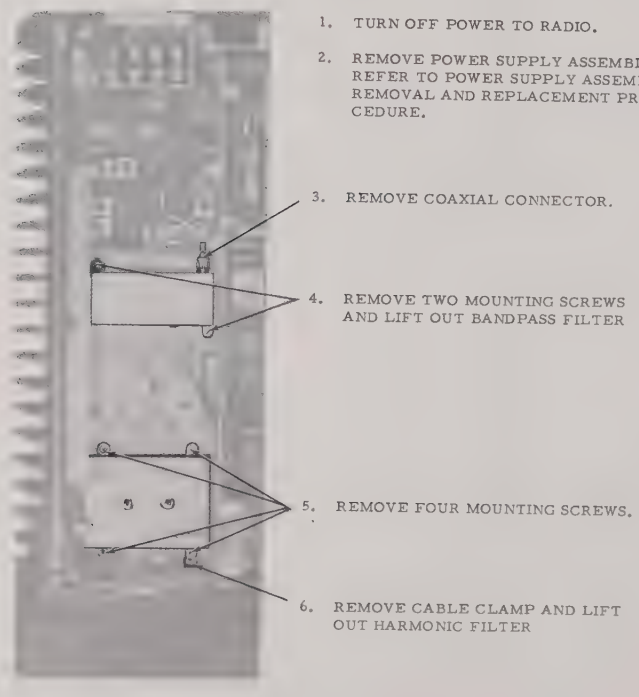
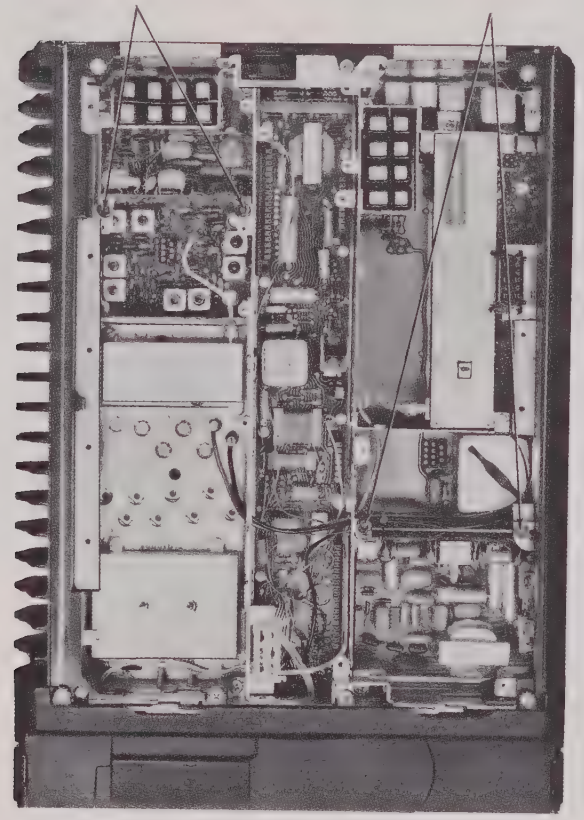


Figure 8.
Removal and Replacement of Bandpass and Harmonic Filters

1. REMOVE POWER SUPPLY ASSEMBLY -- REFER TO POWER SUPPLY ASSEMBLY REMOVAL AND REPLACEMENT PROCEDURE.

2. "PL" ENCODER -- LOOSEN TWO MOUNTING SCREWS AND LIFT OUT BOARD.

3. "PL" DECODER -- LOOSEN TWO MOUNTING SCREWS AND LIFT OUT BOARD



AEPS-6998-O

Figure 9.
"Private-Line" Decoder and Encoder Removal and Replacement

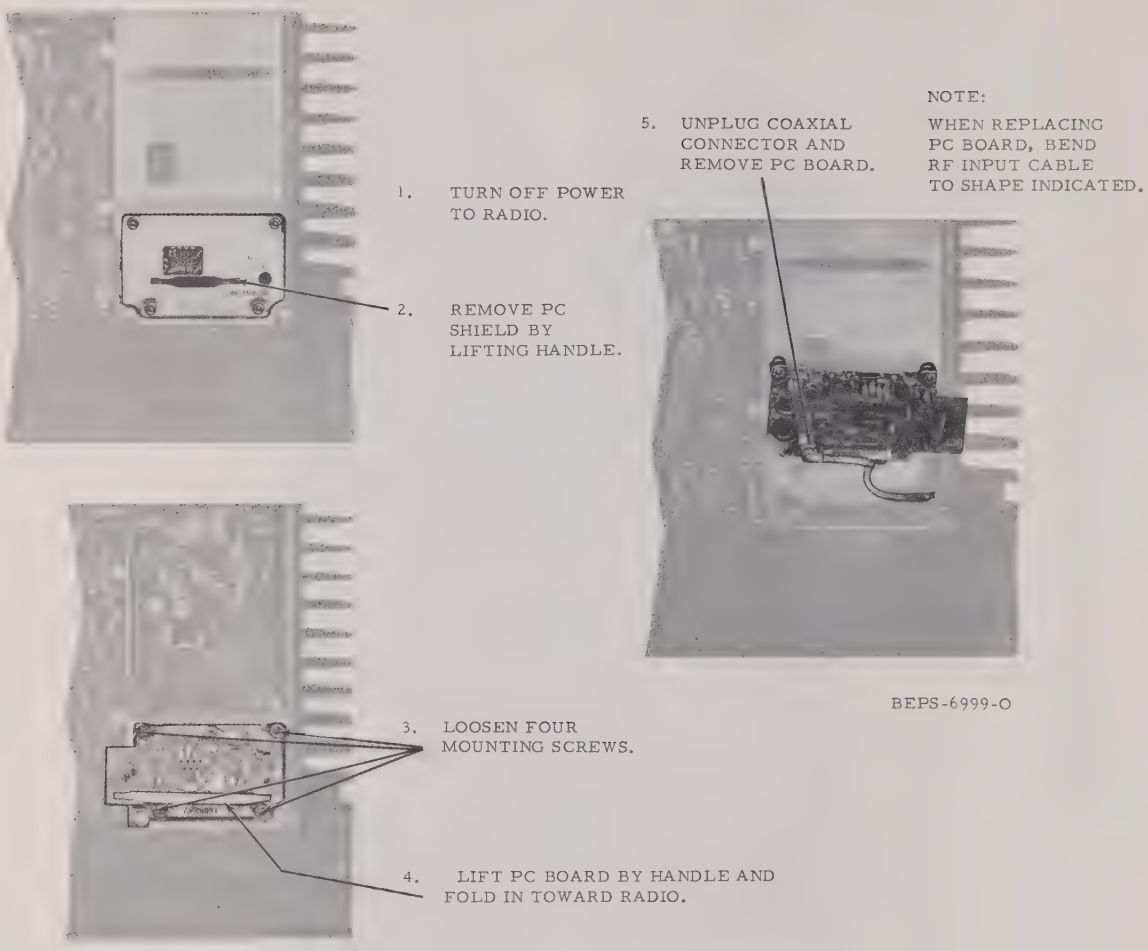


Figure 10.
Power Control Board Removal and Replacement

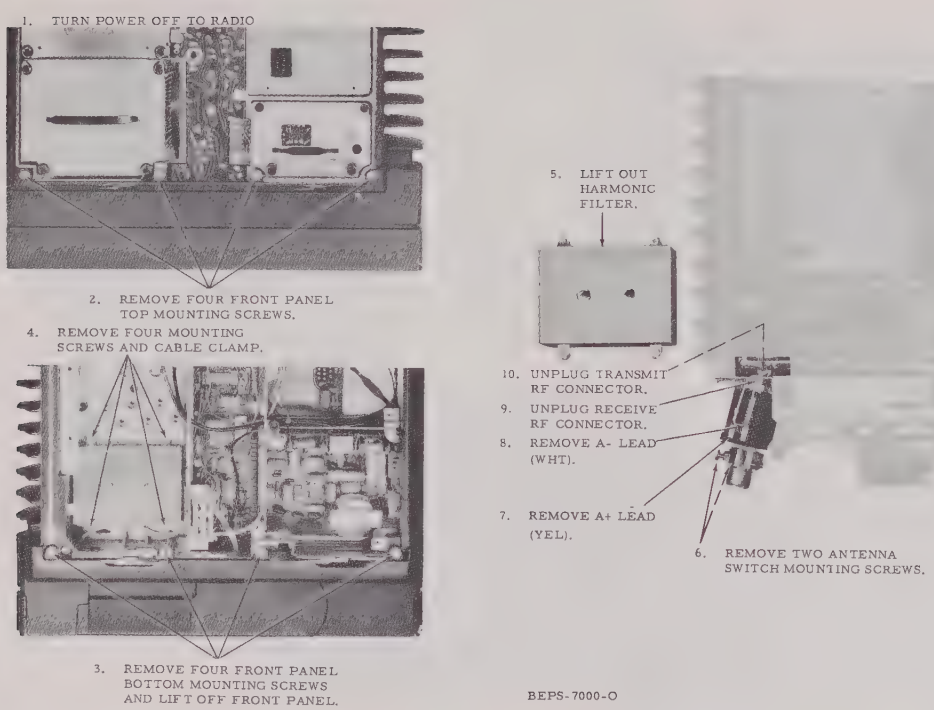


Figure 11.
Antenna Switch Removal and Replacement

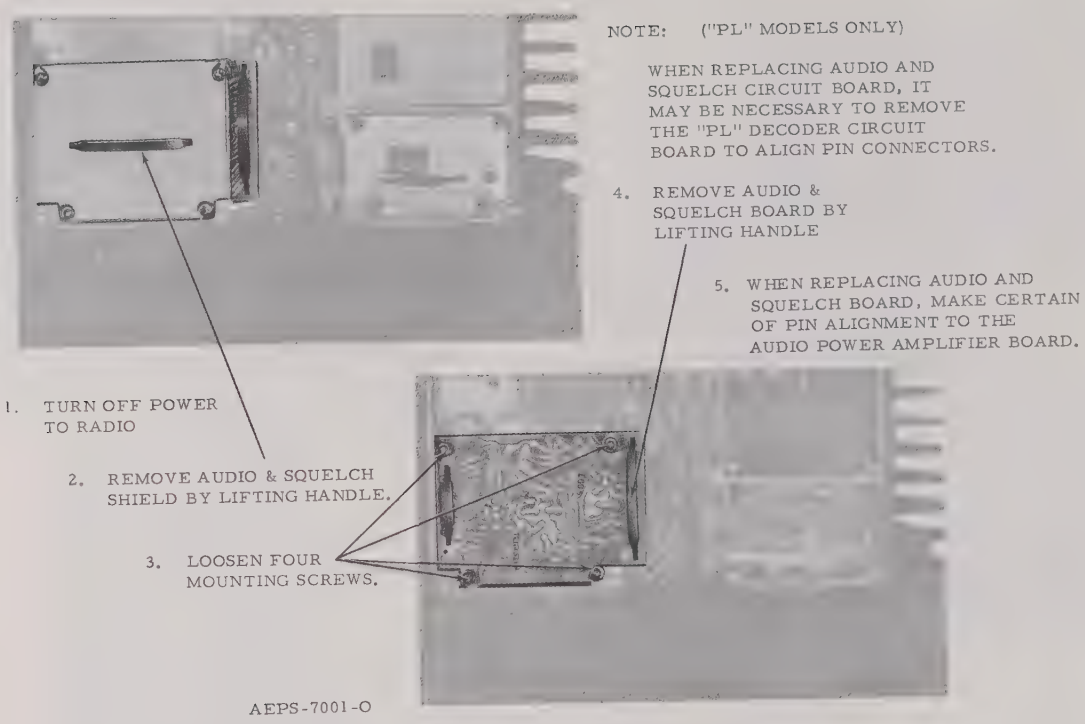
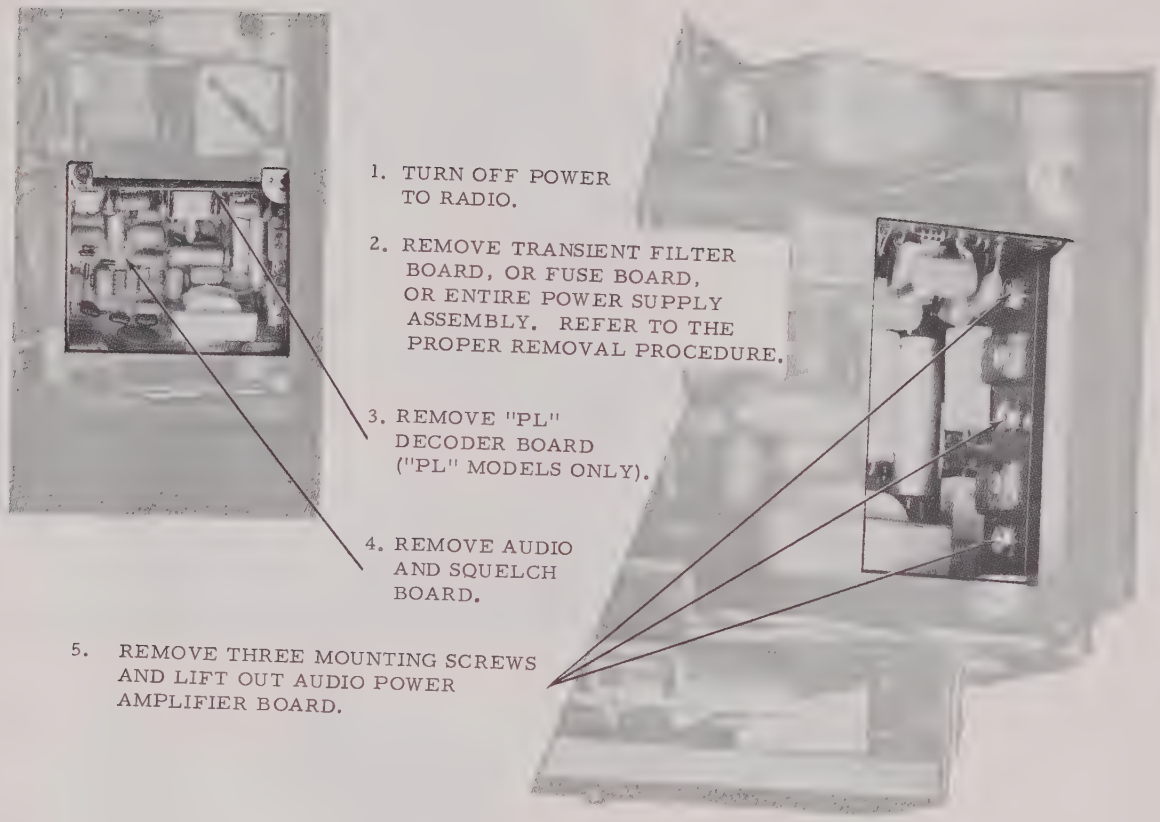


Figure 12.
Receiver Audio and Squelch Board Removal and Replacement



BEPS-7002-O

Figure 13.
Audio Power Amplifier Board Removal and Replacement

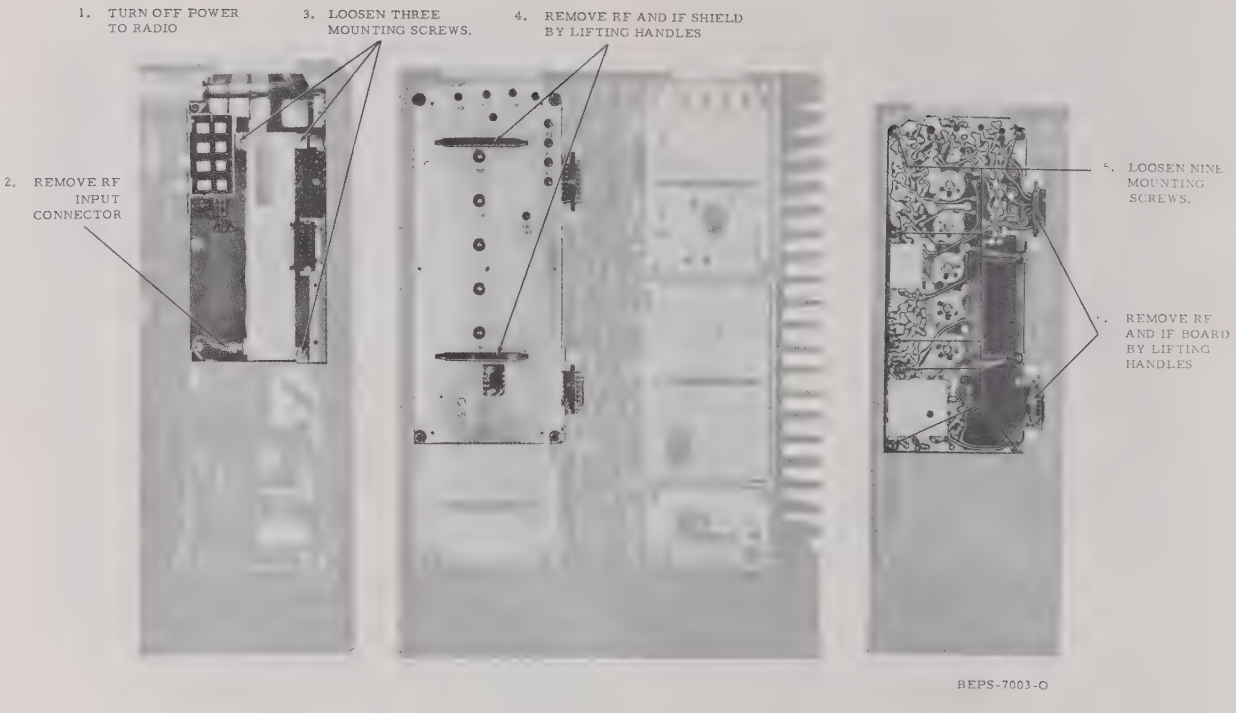


Figure 14.
Receiver RF & IF Board Removal and Replacement

RECEIVER ADJUSTMENTS

RF PREAMPLIFIER ALIGNMENT

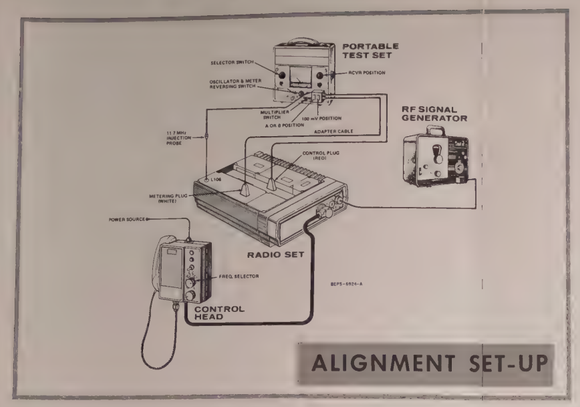
STEP	ADJUST	SELECTOR SWITCH POSITION	OSC. & METER REV. SWITCH	PROCEDURE
1				If radio is equipped with optional preamplifier, disconnect and bypass the preamplifier. Align the receiver then reconnect the preamplifier.
2	L3, L2, L1	5	METER REV.	Adjust L3, L2, and L1 in that order for maximum test set meter indication. Repeat.
3				Tune L2 for maximum quieting.

EPS-7375-O

RECEIVER ALIGNMENT PROCEDURE

STEP	ADJUST	SELECTOR SWITCH POSITION	OSC. & METER REV. SWITCH	STAGE & PROCEDURE
1	L108, L109	3	METER REV.	CHANNEL ELEMENT OUTPUT (3RD HARMONIC) - Adjust L108 and L109 for maximum test set meter indication. On multi-frequency radios make this adjustment with frequency selector switch in F1 position.
2	L107	11 4	A or B (Test Set must be equipped with 11.7 MHz crystal in corresponding socket).	DISCRIMINATOR - Unsquelch the radio set by turning the squelch control on the control board fully counterclockwise. "Private-Line" radios must also be PL disabled by placing the PL monitor switch on the control head in the OFF position. Note test set meter indication in position 11 (muliplier switch in 2 V AC position). Insert 11.7 MHz injection probe of test set into L106 opening of receiver shield being careful not to contact circuit board. Insert probe into hole far enough to obtain reading 1/10 of that noted at beginning of this step (signal is "sprayed" into radio). Adjust L107 for 0 center reading on top scale with selector switch of test set in position 4. Adjustment is critical and should be exactly on 0. Remove probe.
3	L110, L111	5	METER REV.	MULTIPLIER - Connect signal generator to antenna input and apply a carrier frequency signal. Adjust L110 and L111 for maximum meter indication. If two peaks are observed, use peak with slugs farthest from circuit board. If a meter 5 indication cannot be obtained, connect center conductor of signal generator cable directly to the mixer gate (Q101).
4	L101, L102, L103, L104, L105, L106	5	METER REV.	RF PRESELECTOR AND MIXER - Turn out slugs L101 thru L105 until tip of each tuning screw extends approx. 1/4 inch beyond spring (parts list code 8). Connect signal generator to antenna input and apply carrier frequency signal. Tune L101 thru L105 for peak on meter position 5. Turn slugs L103, L104, and L105 in one turn. Peak L106 thru L101, in that order, on meter position 5. Decrease signal generator output as necessary to maintain indication between 10 and 25 uA.
5	L108, L110, L111	5	METER REV.	Adjust signal generator output for 25 uA meter indication. Detune L108 until meter indication decreases to 15 uA. Repeak L110 and L111 for maximum meter indication. Repeat entire step.
6	L108, L109	3	METER REV.	Repeak L108 and L109 for maximum meter indication.
7	L101, L102, L103, L104, L105	5 11 OFF	METER REV.	Repeak L101 through L105 for maximum meter indication. Repeat. Peak L103 thru L105 for minimum indication on meter 11 (maximum quieting).
8	F1, F2, F3, F4	5 4	METER REV.	ON-FREQUENCY ADJUSTMENT - Disconnect signal generator and transmit carrier signal from transmitter normally received. If transmitter is known to be on frequency, test set meter position 5 should indicate rise when transmitter is keyed (if necessary connect antenna). Check test set position 4 reading with transmitter keyed. 0 indicates on-frequency condition. Adjust F1, F2, F3 and F4 receiver warp capacitors for exact 0 reading in corresponding frequency selector switch positions. DO NOT READJUST L108 OR L109 AFTER THESE ADJUSTMENTS ARE MADE. If radio is equipped with AFC, short the AFC DISABLE contact while adjusting F1, F2, F3 and F4.
9	-	-	-	Perform 20 dB quieting sensitivity measurement as check of alignment.

EPS-7376-O



FREQUENCY CALCULATIONS

Where:

f_o = channel element frequency

f_c = carrier frequency

150.8-174 MHz

$$f_o = \frac{f_c - 11.7\ MHz}{9}$$

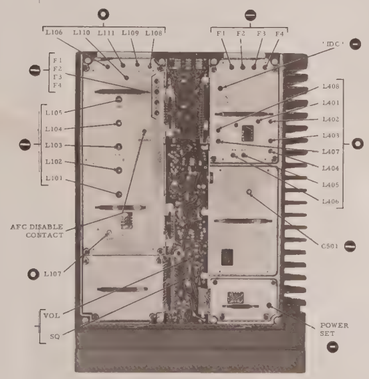
EPS-7378-O

20 DB QUIETING SENSITIVITY CHECK

1. Unsquelch the radio set by turning the SQ (squelch) control on the control board fully counterclockwise. "Private-Line" radios must also be PL disabled by placing the PL monitor switch in the OFF position.
2. Connect the red "control" plug of the adapter cable to the control receptacle on the radio set.
3. Set the multiplier switch on the test set in the 2 V AC position.
4. Adjust the VOL (volume) control on the control board until 2 volts is obtained on meter position 11. To silence the speaker during the test, set the speaker switch of the test set in the LOAD position and disconnect the speaker.
5. Connect the signal generator to the radio set antenna receptacle and adjust it to the receiver frequency. Set the rf output to minimum.
6. Increase the signal generator output until the meter reading drops to 0.2 volt in meter position 11 (place the multiplier switch in the 0.2 V AC position). The generator output level now indicates the 20 dB quieting sensitivity and should be 0.5 microvolt, or less (0.25 microvolt with preamplifier).

EPS-7379-O

ADJUSTMENT LOCATIONS



AEPS-6955-O

TRANSMITTER ADJUSTMENTS

OSCILLATOR FREQUENCY ADJUSTMENT

1. Set up the test equipment as shown for frequency measurement. Disconnect the audio oscillator from the portable test set.
2. Key the transmitter with no modulation. Key the transmitter with the XMTR ON pushbutton on the portable test set rather than with the handset. On "Private-Line" radios, turn the PL tone OFF.
3. Adjust the channel element warp capacitor for the selected channel to the exact desired frequency. Adjust the warp capacitor which corresponds to the frequency selector switch setting on the control head: repeat for each frequency.

"IDC" ADJUSTMENT PROCEDURE

1. Set up the test equipment as shown for deviation measurement. Connect the audio oscillator to the portable test set.
2. Set the audio oscillator to 1000 Hz and 3 volts. On "Private-Line" models, replace the "Vibrasender" resonant reed.
3. Key the transmitter and adjust the IDC control for ±5 kHz deviation.
4. Reduce the tone oscillator output to 0.45 volts. Essentially full deviation should still be indicated.

FREQUENCY CALCULATIONS

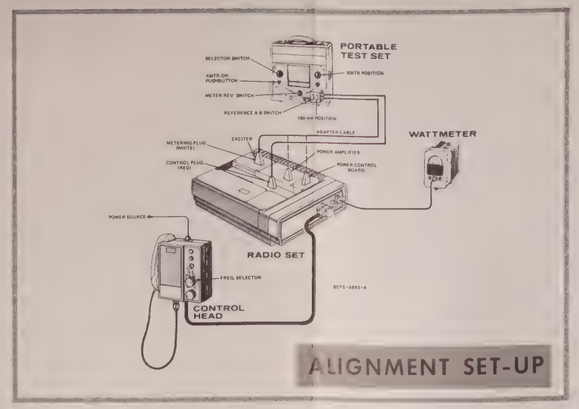
Where:

f_o = channel element frequency

f_c = carrier frequency

$$f_o = \frac{f_c}{12} \qquad f_c = 12\ f_o$$

EPS-7380-C



TRANSMITTER ALIGNMENT PROCEDURE

STEP	ADJUST	METERING PLUG LOCATION	TEST SET SELECTOR SWITCH POSITION	OSC. & METER REV. AND ADAPTER CABLE REF. SWITCHES	STAGE AND PROCEDURE
1					SET-UP - Connect the test equipment and set switches as shown. Key the transmitter with the XMTR ON pushbutton on the portable test set.
2	POWER SET				OUTPUT - Turn the POWER SET control fully counterclockwise.
3	FREQUENCY SWITCH	EXCITER	2	OFF REF A	CHANNEL ELEMENT - Select the desired frequency. Key the transmitter. The test set meter 2 should indicate at least 10 uA.
4	ALL EXCITER COILS	EXCITER	3	OFF REF A	PRE-ALIGNMENT - If the exciter is completely untuned and shows no meter 3 reading, set cores of all tuning coils to the top of their coil forms (away from circuit board) and proceed with step 5. If the exciter shows meter 3 readings, set cores of all tuning coils except L401 and L402 to the top of their coil forms (away from the circuit board). Tune L401 and L402 in that order for maximum meter indication. Go to step 7 of the procedure.
5	L401	EXCITER	2	OFF REF A	MODULATOR OUTPUT - Tune L401 for minimum meter reading.
6	L401, L402	EXCITER	3	OFF REF A	MODULATOR OUTPUT - Tune L402, then L401 for peak meter reading.
7	L403	EXCITER	2	OFF REF A	TRIPLER OUTPUT - Tune L403 for minimum meter reading.
8	L403, L404	EXCITER	4	OFF REF A	TRIPLER OUTPUT - Tune L404 and then L403 for peak meter reading.
9	L405	EXCITER	4	OFF REF A	FIRST DOUBLER OUTPUT - Tune L405 for minimum meter reading.
10	L405, L406	EXCITER	4	OFF REF A	FIRST DOUBLER OUTPUT - Tune L406 and then L405 for peak meter reading.
11	L407	EXCITER	2	OFF REF A	EXCITER OUTPUT - Tune L407 for minimum meter reading.
12	L407, L408	PA	1	METER REV. REF A	EXCITER OUTPUT - Move the metering plug to the PA. Tune L408 and then L407 for peak meter reading.
13					Repeat steps 6, 8 and 10.
14					Align the power amplifier.
15					For complete power amplifier tune-up, proceed with step 16. To check alignment, move metering plug to power control board and go to step 20.
16	C501				PA PRE-ALIGNMENT - Set capacitor C501 fully clockwise.
17	POWER SET C501	POWER CONTROL BOARD	5	METER REV. REF B	OUTPUT - Move metering plug to the power control board. Gradually rotate the POWER SET control until an initial meter 5 reading is observed. Do not readjust POWER SET control. If this indication is less than 50 uA (full scale), proceed with step 18. If this indication is greater than 50 uA, tune C501 for an on-scale reading.
18	POWER SET	POWER CONTROL BOARD	Wattmeter or 1	METER REV. REF A	OUTPUT - Without exceeding rated power output of 45 watts on wattmeter or calibration label value on meter 1, adjust the POWER SET control for rated power or until no further increase in power output is observed. Then adjust the POWER SET control counterclockwise for an approximate 5 W reduction on the wattmeter or 3 uA reduction from meter 1 reading.
19	C501	POWER CONTROL BOARD	5	METER REV. REF B	PA DRIVER OUTPUT - Tune C501 for minimum meter 5 reading.
20	POWER SET	POWER CONTROL BOARD	Wattmeter or 1 5	METER REV. REF A METER REV. REF B	OUTPUT - Adjust the POWER SET control for rated power output and repeat step 19 (if rated power cannot be attained, repeat steps 18 and 19). For continuous duty operation, adjust POWER SET control for 40 W. (Canadian units set for 30 W.) Check meter 5 reading, it must not exceed 50 uA.
21		PA	5	METER REV. REF B	FINAL COLLECTOR CURRENT - Move the metering plug to the PA. Measure the final collector current (Ic). Ic in amperes is the meter 5 reading (0-50 uA) x 2 x 10^5.
22		PA	6	METER REV. REF B	FINAL COLLECTOR VOLTAGE - Measure the final collector voltage (Vc). Vc is the meter 6 reading (0-30 volt scale).
23					Determine final input power (Pin). Pin equals Vc x Ic. Pin should be less than 90 watts.

EPS-7382-O

TEST BENCH POWER SUPPLIES

REQUIREMENTS

Transmit: 117 V rms @ 300 W or 13.6 V dc @ 16.5 A
Receive: 117 V rms @ 50 W or 13.6 V dc @ 1 A

APPROVED POWER SUPPLIES

Variable transformer (VARIAC) 0-140 V ac
Motorola Model ST460 AC Line Monitor

Motorola S1393A or S1305A Regulated Power Supply
12-Volt Automative Battery used with Motorola T1012A Power Supply used as a battery charger.

NEPS-14994-O

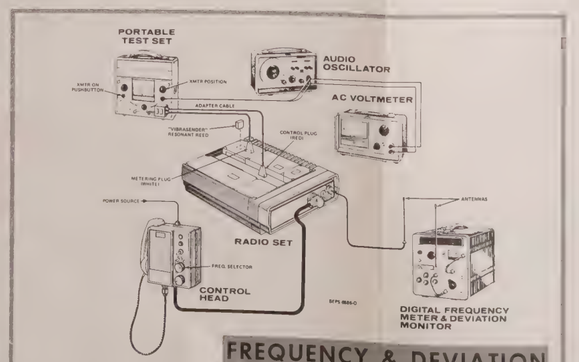
PEPS-14992-O

EXCERPTS FROM FCC REGULATIONS

FCC Regulations state that:

1. Radio transmitters may be tuned or adjusted only by persons holding a first or second class commercial radiotelephone operator's license or by personnel working directly under their immediate supervision.
2. The power input to the final radio frequency stage shall not exceed the maximum figure specified on the current station authorization. This power input shall be measured and the results recorded:
   a. When the transmitter is initially installed,
   b. When any change is made in the transmitter which may increase the power input.
   c. At intervals not to exceed one year.
3. Frequency and deviation of a transmitter must be checked:
   a. When it is initally installed,
   b. When any change is made in the transmitter which may affect the carrier frequency or modulation characteristics.
   c. At intervals not to exceed one year.

EPS-7381-O



NOTE:

THIS SERVICE SHEET SHOWS INFORMATION PERTAINING TO CURRENT PRODUCTION MODELS ONLY. FOR SERVICING INFORMATION CONCERNING EARLIER EQUIPMENT MODELS, REFER TO THE INSTRUCTION MANUAL.

NEPS-14995-O

MOTOROLA SERVICE SHEET

150.8-174 MHz RAILROAD "MICOR"

Fm Two-Way Radio Sets

MODELS — R43RTB-1190AA R43RTB-3190AA

117 V AC OPERATION (13.6 V DC EMERGENCY OPERATION)

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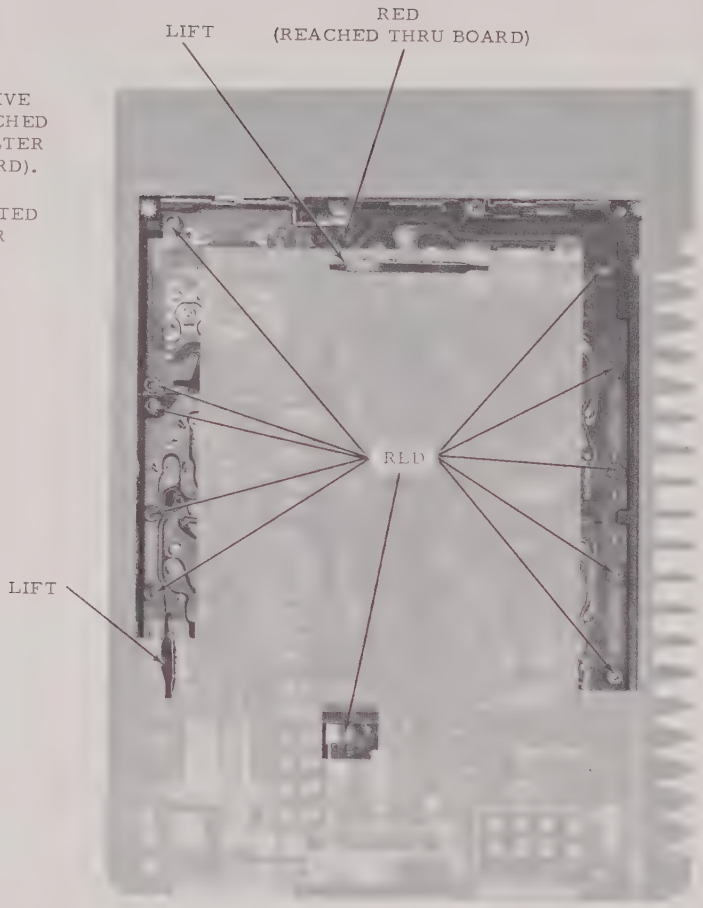
8/1/74

ENGINEERING PUBLICATIONS
1301 E. ALGONQUIN ROAD
SCHAUMBURG, ILLINOIS 60172

68P81106E40-A

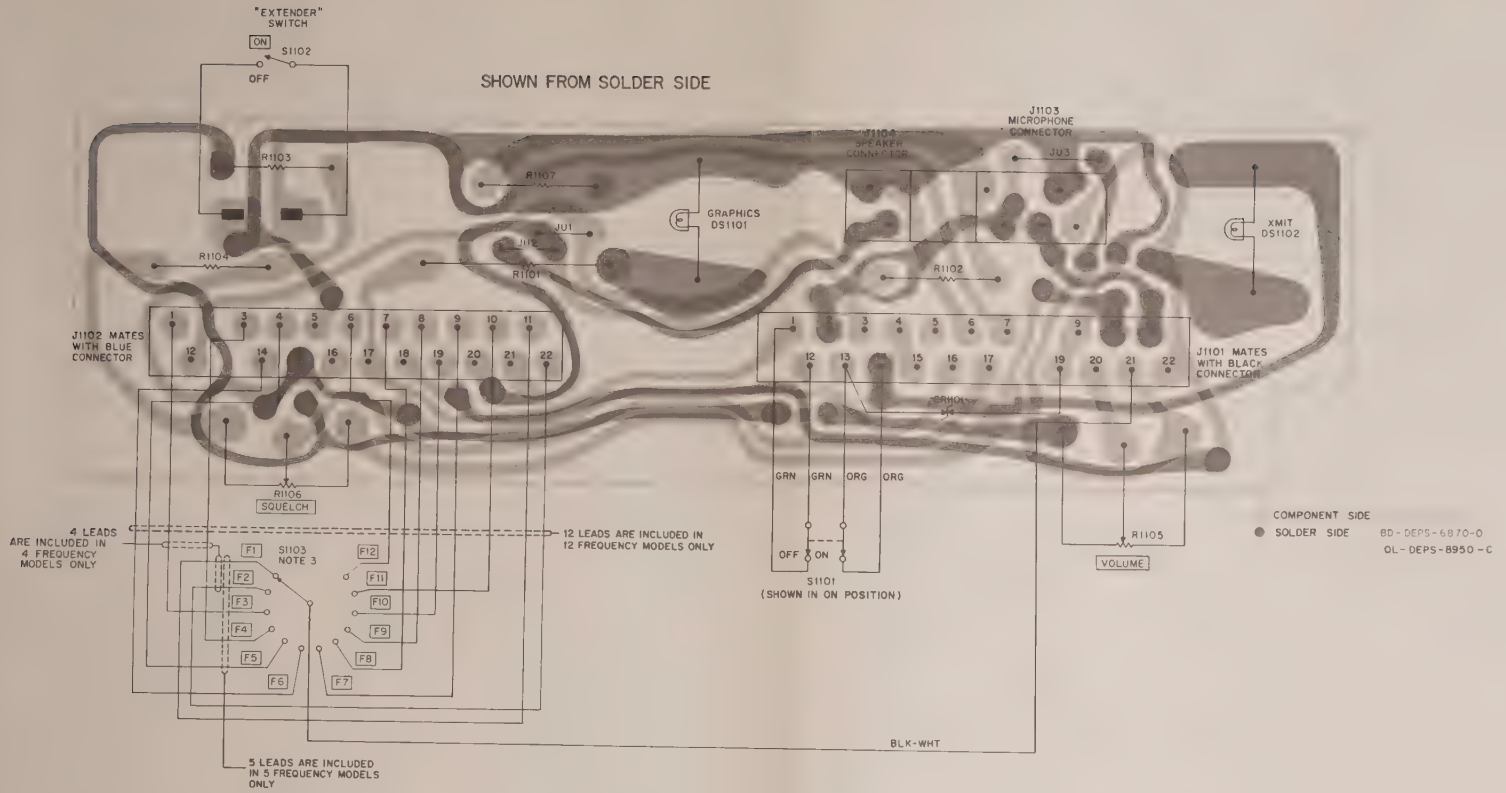
1. LOOSEN "RED" CAPTIVE SCREWS (ONE IS REACHED THRU TRANSIENT FILTER BOARD OR FUSE BOARD).

2. USE HANDLES INDICATED AND LIFT OUT POWER SUPPLY ASSEMBLY



BEPS-7006-O

Figure 16.
Power Supply Assembly Removal and Replacement



NOTES

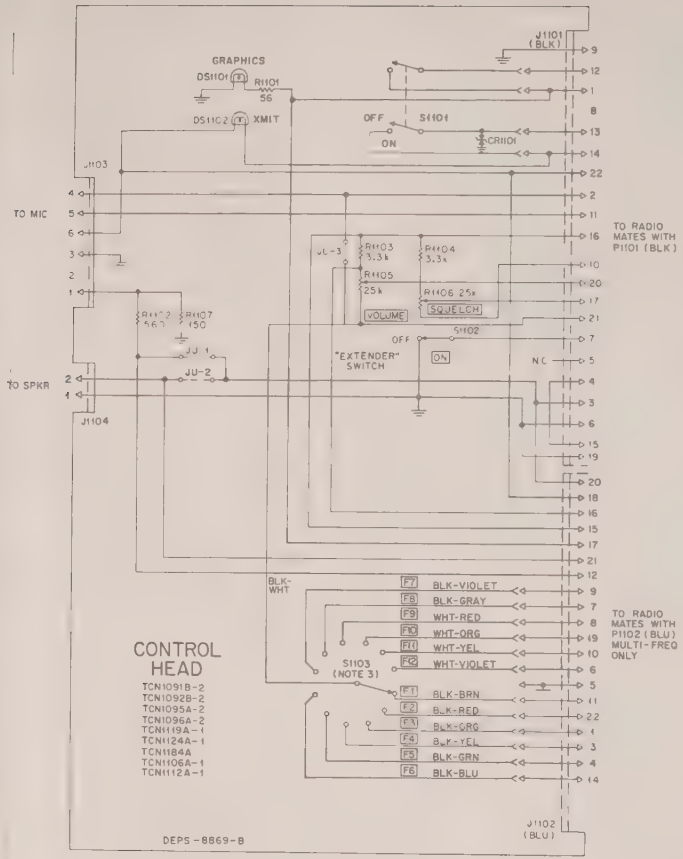
1. FOR PROPER OPERATION OF THIS CONTROL HEAD WITH HANDSET (TMN6057A) AND HANDSET HANG-UP SWITCH BOX (TLN4504A) REFER TO THEIR RESPECTIVE MANUALS.
2. FOR PROPER OPERATION OF THIS CONTROL HEAD WITH VOICE PRIVACY ADAPTER (TLN1400A) REFER TO VPA MANUAL.
3. S1103 USED ONLY FOR MULTIPLE FREQUENCY CONTROL HEADS
   POSITIONS 1-4 WIRED FOR 4 FREQUENCY MODELS
   POSITIONS 1-5 WIRED FOR 5 FREQUENCY MODELS
   POSITIONS 1-8 WIRED FOR 8 FREQUENCY MODELS
   POSITIONS 1-12 WIRED FOR 12 FREQUENCY MODELS

EPS-6944 A

REVISIONS

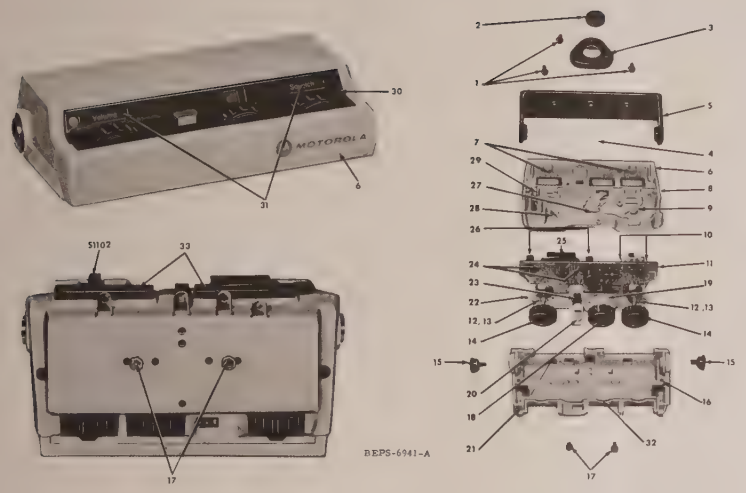
63P81019E29-D

CHASSIS AND SUFFIX NO.	REF SYMBOL	CHANGE	LOCATION
TCN1091B-2 TCN1092B-2 TCN1095A-2 TCN1096A-2 TCN1119A-1 TCN1124A-1	CR1101	ADDED 48D81461B45 ADDED BLK/WHT LEAD BETWEEN R1105 and S1101	S1101
TCN1184A		ADDED MODF1	SCHEMATIC DIAGRAM AND PARTS LIST



CONTROL HEAD

Control Head Schematic Diagram and Circuit Board Detail
Motorola No. 63P81019E29-E
12/27/76-NPC



MECHANICAL PARTS LIST

IMPORTANT

USE ONLY THE FOLLOWING MOTOROLA PART NUMBERS WHEN ORDERING REPLACEMENT PARTS

CONTROL HEAT MODELS

TCN1091B (Single-Freq.)	TCN1106A (8-Freq.)
TCN1092B (4-Freq.)	TCN1112A (8-Freq.)
TCN1095A (Single-Freq.)	TCN1119A (12-Freq.)
TCN10961 (4-Freq.)	TCN1124A (12-Freq.)
	TCN1184A (5-Freq.)

PL-1048-I

CODE NUMBER	MOTOROLA PART NO.	DESCRIPTION
1	3S136756	SCREW, tapping; 10-16 x 5/8" plain hex flanged head; does not include 4S7652 LOCKWASHER: No. 10 external
2	49C84961C01	DISC, trunnion bracket mounting; "breakaway" type (TCN1091B and TCN1092B)
3	42D84963C01	COLLAR, trunnion bracket mounting (TCN1091B, TCN1092B)
4	3S115727	LOCKSCREW, machine; 10-32 x 1/2" plain hex head (TCN1091B, TCN1092B)
5	7C84576B01	BRACKET, trunnion (TCN1091B, TCN1092B)
6	75B84628B01	FRONT COVER, housing ("bumper")
7	3S136963	SCREW, tapping: 6-20 x 5/16" "Phillips" flat head
8	1V80712B88	TOP COVER ASSEMBLY, housing; includes items coded 6, 7, 9, 27, 28, 29, 31 (multi-freq. models)
	or	
	1V80757B65	TOP COVER ASSEMBLY, housing; includes items coded 6, 7, 9, 28, 29 and 31 (single-freq. models)
9		PRISM, optical (SEE NOTE)
10	3S129675	LOCKSCREW, 4-40 x 1/4" "Phillips" binder head with lockwasher
11	TLN4369B	PLATED CIRCUIT BOARD ASSEMBLY; includes contact terminals
12	2S136272	NUT, machine; 3/8-32 x 1/2" hex
13	4S8210	WASHER, metallic; 0.39" x 0.562" x 0.16"
14	36D84001C02	KNOB, control (volume & squelch)
15	3B84546B01	SCREW, machine; shoulder type (trunnion-mount)
16	3B84548B01	SCREW, machine; 6-32 x 1/2" "Phillips" round head; "captive" type
17	3S136138	LOCKSCREW, machine; 6-32 x 3/8" "Phillips" hex head
18	36D84001C01	KNOB, control; (freq. selector) (requires use of item coded 19)
19	36D84006C01	DISC, switch position indicator (used with item coded 18)
20	45C84004C01	ACTUATOR, switch
21	15E84920B01	HOUSING, (bottom section)
22	7C84005C01	BRACKET (chassis)
23	1V80712B89	SWITCH ASSEMBLY: (slide switch); includes wires, contact terminals and mounting screws
24	3S135084	LOCKSCREW, tapping; 4-40 x 5/16" "Phillips" fillister head
25	42D84067C01	RETAINER, connector
26	9B84627B01	LAMPHOLDER
27, 28		PRISM, optical (SEE NOTE)
29		PRISM, optical; includes RED LENS (SEE NOTE)
30	13D84000C02	BEZEL (single-frequency)
	or 13D84000C01	BEZEL (multi-frequency)
31	33C84038C01	MARKER STRIP (VOLUME, SQUELCH)
32	38B84357C01	PLUG, SNAP-IN (single-freq.)
33	42C84962C01	RETAINER, connector

REFERENCE SYMBOL	MOTOROLA PART NO	DESCRIPTION
		NON-CODED ITEM
	54B84111D01	MOUNTING TEMPLATE (TCN1091B, TCN1092B)

NOTE: Items coded 9, 27, 28 and 29 are not individually replaceable. For field-replacement, order item No. 8 (TOP COVER ASSEMBLY).

ELECTRICAL PARTS LIST

PL-1049-G

CR1101	48D83461E45	DIODE: SEE NOTE diode; Zener type; nom. 25 V
		LAMP, incandescent: miniature wedge base:
DS1101	65B83554G01	12 V; 0.19 A; type No. 161
DS1102	65B83554G01	12 V; 0.19 A; type No. 161
		CONNECTOR, receptacle:
J1101		c/o (20) 29B84547B01 TERMINALS, pin: male
J1102		c/o (20) 29B84547B01 TERMINALS, pin: male
J1103		c/o (5) 29B84547B01 TERMINALS, pin: male
J1104		c/o (2) 29B84547B01 TERMINALS, pin: male
		RESISTOR:
R1101	6S488090	fixed: 56 ±10%; 2 W
R1102	6S6291	fixed: 560 ±10%; 1/2 W
R1103	6S5581	fixed: 3.3k ±10%; 1/2 W
R1104	6S5581	fixed: 3.3k ±10%; 1/2 W
R1105	18C84584A02	variable: 25k ±30%; 1/4 W
R1106	18C84584A02	variable: 25k ±30%; 1/4 W
R1107	6S6373	fixed: 150 ±10%; 1/2 W
		SWITCH:
S1101	40C84622B02	slide: dpst; does not include 29S10134A86 LUG, connector: female; 4 required
S1102	40C84301C02	momentary slide; spst
S1103	40C84149C01	rotary; 4-position; non-shorting includes mounting hardware & adjustable stopwasher (not available separately)
	40C84149C02	rotary; 8-position; non-shorting includes mounting hardware and (2) adjustable stopwashers (not available separately)
	40C84149C03	rotary; 12 position; non-shorting includes a fixed non-adjustable stop; does not include mounting hardware
		NON-REFERENCED ITEMS
	TLN4369B	PRINTED CIRCUIT BOARD ASSEMBLY; includes 29B84547B01 TERMINAL, contact; male; 47 required 42C84962C01 RETAINER, connector; 2 required
	4-2636	LOCKWASHER: 3/8" internal tooth (for 12-freq. switch)
	2-136272	NUT, hex: 3/8"-32 x 1/2" (for 12-freq. switch)

NOTE:
Replacement diodes must be ordered by Motorola part number only for optimum performance.

RECEIVER ADJUSTMENTS

RF PREAMPLIFIER ALIGNMENT

STEP	ADJUST	SELECTOR SWITCH POSITION	OSC. & METER REV. SWITCH	PROCEDURE
1				If radio is equipped with optional preamplifier, disconnect and bypass the preamplifier. Align the receiver then reconnect the preamplifier.
2	L3, L2, L1	5	METER REV.	Adjust L3, L2, and L1 in that order for maximum test set meter indication. Repeat.
3				Tune L2 for maximum quieting.

EPS-7249-O

RECEIVER ALIGNMENT PROCEDURE

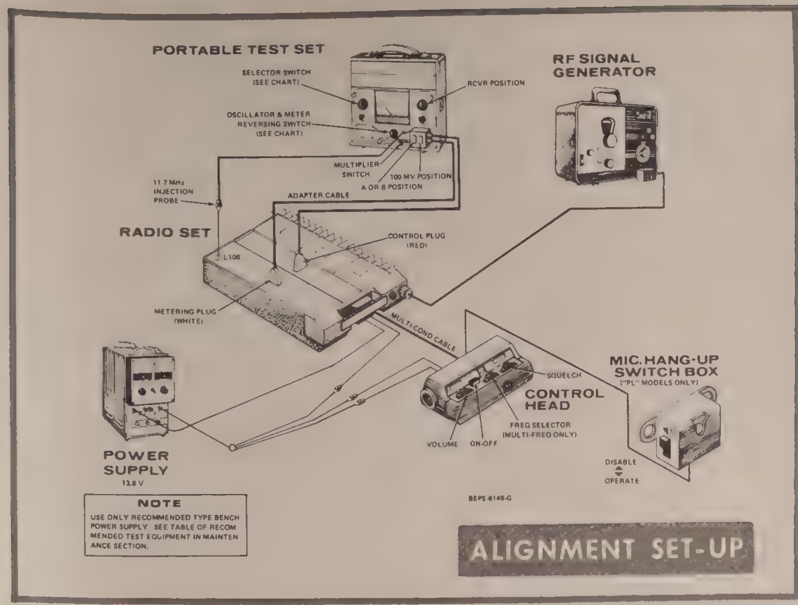
STEP	ADJUST	SELECTOR SWITCH POSITION	OSC. & METER REV. SWITCH	STAGE AND PROCEDURE
1	L108, L109	3	METER REV.	CHANNEL ELEMENT OUTPUT (3RD HARMONIC) - Adjust L108 and L109 for maximum test set meter indication. On multi-frequency radios make this adjustment with frequency selector switch in F1 position.
2	L107	11 4	A or B (Test Set must be equipped with 11.7 MHz crystal in corresponding socket).	DISCRIMINATOR - Unsquelch the radio set by turning the squelch control on the control head fully counterclockwise. "Private-Line" radios must also be PL disabled by removing the microphone from the hang-up box or placing the PL monitor switch on the box in the off position. Note test set meter indication in position 11 (multiplier switch in 2 V AC position). Insert 11.7 MHz injection probe of test set into L106 opening of receiver shield being careful not to contact circuit board. Insert probe into hole far enough to obtain reading 1/10 of that noted at beginning of this step (signal is "sprayed" into radio). Adjust L107 for 0 center reading on top scale with selector switch of test set in position 4. Adjustment is critical and should be exactly on 0. Remove probe.
3	L110, L111	5	METER REV.	MULTIPLIER - Connect signal generator to antenna input and apply a carrier frequency signal. Adjust L110 and L111 for maximum meter indication. If two peaks are observed, use peak with slugs farthest from circuit board. If a meter 5 indication cannot be obtained, connect center conductor of signal generator cable directly to the mixer gate.
4	L101, L102, L103, L104, L105, L106	5	METER REV.	RF PRESELECTOR AND MIXER - Turn out L101 thru L105 slugs until tip of each tuning screw extends approx. 1/4 inch beyond spring (parts list code 8). Connect signal generator to antenna input and apply carrier frequency signal. Tune L101 thru L105 for peak on meter position 5. Turn L103, L104, and L105 slugs in one turn. Peak L106 thru L101, in that order, on meter position 5. Decrease signal generator output as necessary to maintain indication between 10 and 25 uA.
5	L108, L110, L111	5	METER REV.	Adjust signal generator output for 25 uA meter indication. Detune L108 until meter indication decreases to 15 uA. Repeak L110 and L111 for maximum meter indication. Repeat entire step.
6	L108, L109	3	METER REV.	Repeak L108 and L109 for maximum meter indication.
7	L101, L102, L103, L104, L105	5 11	METER REV OFF	Repeak L101 through L105 for maximum meter indication. Repeat. Peak L103 thru L105 for minimum indication on meter 11 (maximum quieting).
8	F1, F2, F3, F4	5 4	METER REV.	ON-FREQUENCY ADJUSTMENT - Disconnect signal generator and transmit carrier signal from transmitter normally received. If transmitter is known to be on frequency test set meter position 5 should indicate rise when transmitter is keyed (if necessary connect antenna). Check test set position 4 reading with transmitter keyed. 0 indicates on-frequency condition. Adjust F1, F2, F3 and F4 receiver warp capacitors for exact 0 reading in corresponding frequency selector switch positions. DO NOT READJUST L108 OR L109 AFTER THESE ADJUSTMENTS ARE MADE. If radio is equipped with AFC, short the AFC DISABLE contact while adjusting F1, F2, F3 and F4.
9	-	-	-	Perform 20 dB quieting sensitivity measurement as check of alignment.

EPS-7250-O

NOTES:

1. Approved bench power supplies:
   Motorola S1303A or S1305A Regulated Power Supply
   Motorola T1261A Transistorized 24-Volt to 12-Volt Converter driven by Motorola T1012A Power Supply
   12-Volt Automotive battery with Motorola T1012A Power Supply used as a battery charger

EPS-7251-O



ALIGNMENT SET-UP

20 DB QUIETING SENSITIVITY CHECK

1. Unsquelch the radio set by turning the SQUELCH Control on the control head fully counterclockwise. "Private-Line" radios must also be PL disabled by removing the microphone from the hang-up box or placing the PL monitor switch in the off position.
2. Connect the red "control" plug of the adapter cable to the control receptacle on the radio set.
3. Set the multiplier switch on the test set in the 2 V AC position.
4. Adjust the VOLUME control on the control head until 2 volts is obtained on meter position 11. To silence the speaker during the test, set the speaker switch of the tset set in the LOAD position and disconnect the speaker.
5. Connect the signal generator to the radio set antenna receptacle and adjust it to the receiver frequency. Set the rf output to minimum.
6. Increase the signal generator output until the meter reading drops to .2 volt in meter position 11 (place the multiplier switch in the .2 V AC position). The generator output level now indicates the 20 dB quieting sensitivity and should be 0.5 microvolt, or less (0.25 microvolt with preamplifier).

EPS-7253-O

FREQUENCY CALCULATIONS

Where:

f_o = channel element frequency

f_c = carrier frequency

132-150.8 MHz

$$f_o = \frac{f_c + 11.7\ \text{MHz}}{9}$$

150.8-174 MHz

$$f_o = \frac{f_c - 11.7\ \text{MHz}}{9}$$

EPS-7252-O

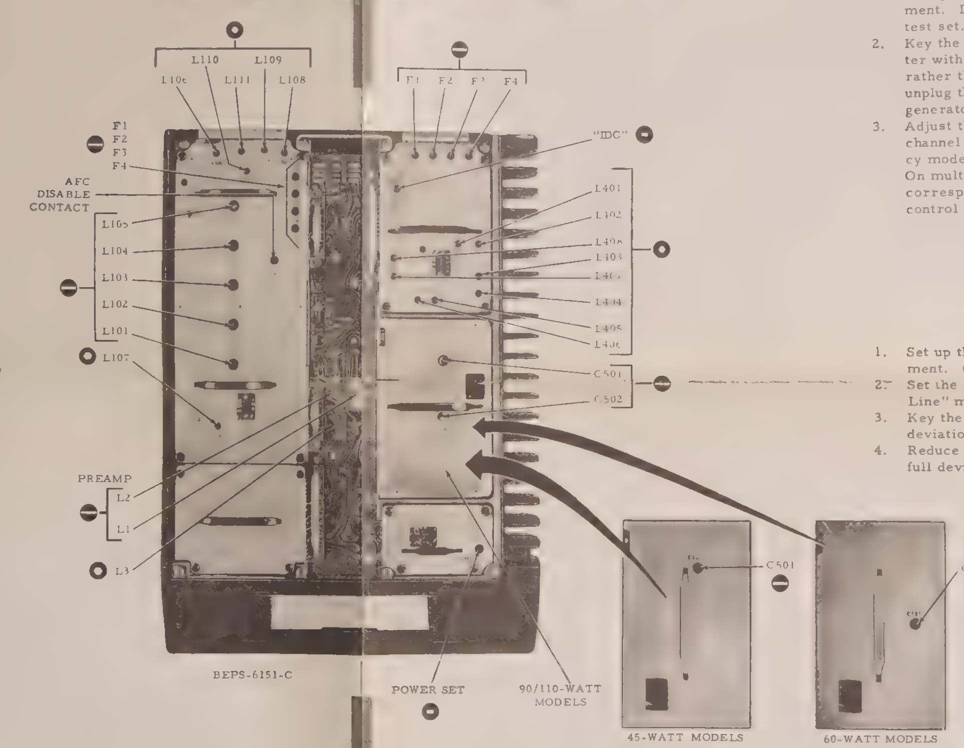
EXCERPTS FROM FCC REGULATIONS

FCC Regulations state that:

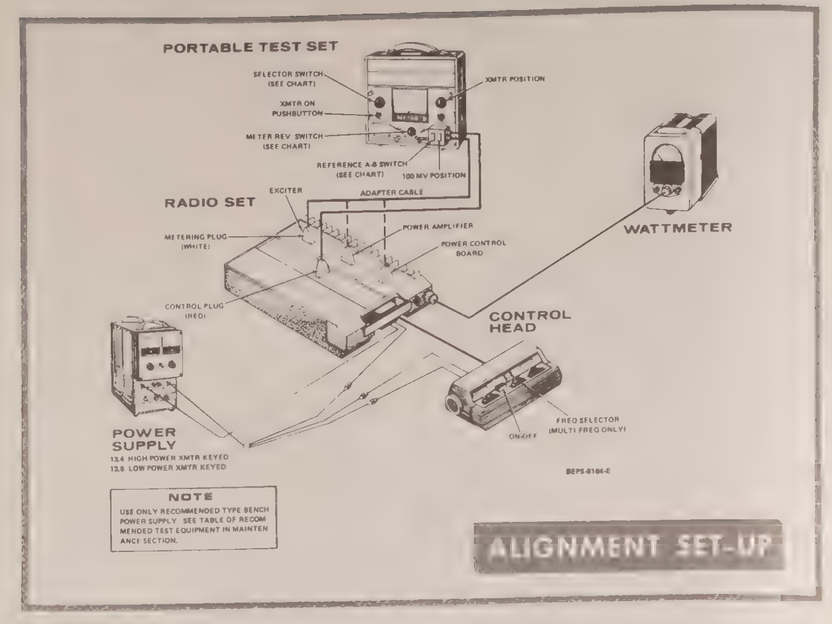
1. Radio transmitters may be tuned or adjusted only by persons holding a first or second class commercial radiotelephone operator's license or by personnel working directly under their immediate supervision.
2. The power input to the final radio frequency stage shall not exceed the maximum figure specified on the current station authorization. This power input shall be measured and the results recorded:
   a. When the transmitter is initially installed.
   b. When any change is made in the transmitter which may increase the power input.
   c. At intervals not to exceed one year.
3. Frequency and deviation of a transmitter must be checked:
   a. When it is initially installed.
   b. When any change is made in the transmitter which may affect the carrier frequency or modulation characteristics.
   c. At intervals not to exceed one year.

EPS-7254-O

ADJUSTMENT LOCATIONS



TRANSMITTER ADJUSTMENTS



ALIGNMENT SET-UP

OSCILLATOR FREQUENCY ADJUSTMENT

1. Set up the test equipment as shown for frequency measurement. Disconnect the audio oscillator from the portable test set.
2. Key the transmitter with no modulation. Key the transmitter with the XMTR ON pushbutton on the portable test set rather than with the microphone. On "Private-Line" radios, unplug the "Vibrasender" resonant reed from the PL tone generator.
3. Adjust the channel element warp capacitor for the selected channel to the exact desired frequency. On single-frequency models, adjust the F1 channel element warp capacitor. On multi-frequency models, adjust the warp capacitor which corresponds to the frequency selector switch setting on the control head; repeat for each frequency.

EPS-7255-O

"IDC" ADJUSTMENT PROCEDURE

1. Set up the test equipment as shown for deviation measurement. Connect the audio oscillator to the portable test set.
2. Set the audio oscillator to 1000 Hz and 1 volt. On "Private-Line" models, replace the "Vibrasender" resonant reed.
3. Key the transmitter and adjust the IDC control for ±5 kHz deviation.
4. Reduce the tone oscillator output to .25 volt. Essentially full deviation should still be indicated.

EPS-7256-O

FREQUENCY CALCULATIONS

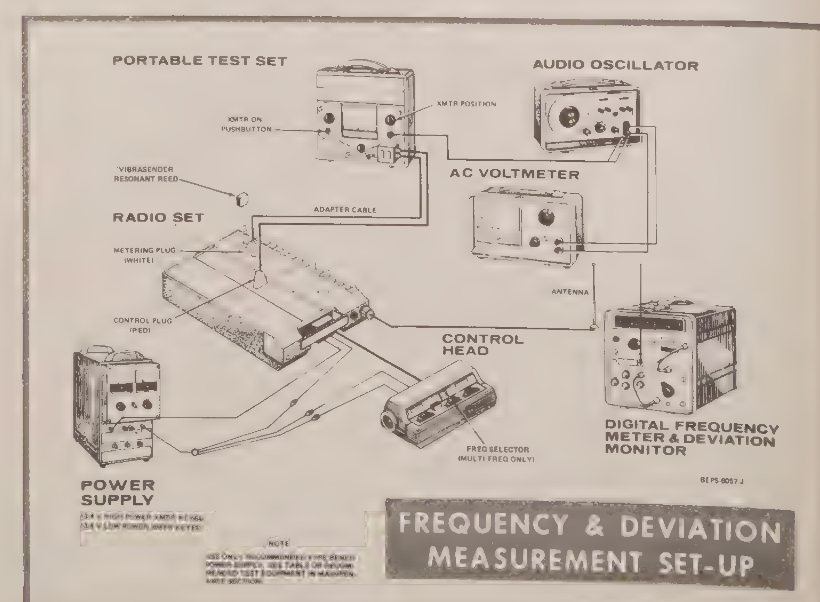
Where:

f_o = channel element frequency

f_c = carrier frequency

$f_o = \frac{f_c}{12}$ $\qquad f_c = 12\ f_o$

EPS-7257-O



FREQUENCY & DEVIATION MEASUREMENT SET-UP

EXCITER ALIGNMENT PROCEDURE

(SEE "EXCERPTS FROM FCC REGULATIONS" ON THIS SHEET)

STEP	ADJUST	METERING PLUG LOCATION	TEST SET SELECTOR SWITCH POSITION	OSC. & METER REV. AND ADAPTER CABLE REF. SWITCHES	STAGE AND PROCEDURE
1					SET UP - Connect the test equipment and set switches as shown. Key the transmitter with the XMTR ON push-button on the portable test set.
2	[illegible]				OUTPUT - Turn the POWER SET control fully counterclockwise.
[illegible]	FREQUENCY SWITCH	EXCITER	2	OFF REF A	CHANNEL ELEMENT - Select the desired frequency on multi-frequency radio sets. Key the transmitter. The test set meter 2 should indicate at least 10 uA.
4	ALL EXCITER COILS	EXCITER	3	OFF REF A	PRE-ALIGNMENT - If the exciter is completely untuned and shows no meter 3 reading, set cores of all tuning coils to the top of their coil forms (away from circuit board) and proceed with step 5. If the exciter shows meter 3 readings, set cores of all tuning coils except L401 and L402 to the top of their coil forms (away from the circuit board). Tune L401 and L402 in that order for maximum meter indication. Go to [illegible] the procedure.
[illegible]	L401	EXCITER	[illegible]	[illegible]	MODULATOR OUTPUT - Tune L401 for minimum meter reading.
[illegible]	L401, L402	EXCITER	[illegible]	[illegible]	MODULATOR OUTPUT - Tune L402 then L401 for peak meter reading.
[illegible]	[illegible]	EXCITER	[illegible]	[illegible]	TRIPLER OUTPUT - Tune L403 for minimum meter reading.
[illegible]	[illegible]	EXCITER	[illegible]	[illegible]	TRIPLER OUTPUT - Tune L404 and then L403 for peak meter reading
[illegible]	[illegible]	EXCITER	[illegible]	[illegible]	FIRST DOUBLER OUTPUT - Tune L405 for minimum meter reading.
[illegible]	[illegible]	EXCITER	[illegible]	[illegible]	FIRST DOUBLER OUTPUT - Tune L406 and then L405 for peak meter reading.
11	[illegible]	EXCITER	5	OFF REF A	EXCITER OUTPUT - Tune L407 for minimum meter reading.
1[illegible]	[illegible]	PA	1	METER REV. REF A	[illegible]CITER OUTPUT - Move the [illegible]ing plug to the PA. Tune L408 [illegible] L407 for peak meter read-[illegible]
1[illegible]					[illegible]peat steps 6, 8, and 10.
1[illegible]					Align the power amplifier.

POWER AMPLIFIER ALIGNMENT PROCEDURE

(45/60/90/110 WATTS)

[illegible] Portable Test Set Meter sensitivity switch should be on 100 n[illegible] or all readin[illegible]

STEP	ADJUST	METERING PLUG LOCATION	[illegible]	[illegible]	PROCEDURE
[illegible]					Turn the POWER SET control fully counterclockwise (minimum power output). If the power amplifier is to be realigned l[illegible]s than ±1 MHz, proc[illegible]ed with step 2. Otherwise, prealign the board by setting C501 fully clo[illegible]wise and C502 fully meshed.
[illegible]	[illegible]	POWER CONTROL BOARD	Wattmeter or 1	METER REV. REF. A	Key transmitter and slowly turn POWER SET control clockwise until rated power is attained, or until no further increase in power output is observed.
[illegible]	POWER SET C501 C502*	POWER CONTROL BOARD	5	METER REV. REF. B	Adjust C501, then C502, for a dip on meter 5. If a dip cannot be found, reduce POWER SET until meter 5 is less than 20 uA.
4		POWER CONTROL BOARD	Wattmeter or 1	METER REV. REF. A	Repeat steps 2 and 3 until rated power is reached. Proceed to step 7 when rated power is attained and meter 5 is less than 30 uA. If rated power cannot be reached and meter 5 is less than 30 uA proceed with step 5. If at this point meter 5 is greater than 30 uA and rated power has not been attained, refer to the power control troubleshooting chart.
[illegible]	R[illegible]	POWER CONTROL BOARD	Wattmeter or 1	METER REV. REF. A	Remove the power control board shield. Use tuning to[illegible] 6A82846D01, or equivalent, to adjust R610. Access to this control is provided by a small slot located approximately 3/4-inch from the POWER [illegible]ET hole, toward the rear of the radio. Use the tuning tool to rotate the outer edge of the serrated knob toward the heat sink until either rated power is attained [illegible] further increase in power output is [illegible]erved. Replace power control shield.
[illegible]					[illegible] at steps 3 and 4.
[illegible]		PA	[illegible]	METER REV. REF. B	[illegible]AL COLLECTOR CURRENT - Move [illegible]ing plug to the PA. Measure the final collector current (Ic). Ic, in amperes, is the meter 5 reading (10 A full scale) for 45- and 60-watt models; meter 5 r[illegible]ding (25 A full scale) for 90/110-watt models.
[illegible]		PA	[illegible]	METER REV REF. B	FINAL COLLECTOR VOLTAGE - Measure the final collector voltage (Vc). Vc is the meter 6 reading (0-[illegible]0 V scale).
[illegible]					Determine the final input power (Pin). Pin [illegible]uals Vc x Ic. Pin should be less than: 90 W for 45 W models 120 W for 60 W models 180 W for 90 W models 200 W for 110 W models If Pin exceeds the[illegible] levels, refer to Power Amplifier Troubleshooting Chart.

*C502 is used only on 90/110 watt models.

EPS-6543-B

SERVICE SHEET

MOTOROLA

132-174 MHZ "MICOR"®

FM Two-Way RADIO SETS

T43RTN-1100A	T53RTN-1100A	T63RTN-1100A	T73RTN-1100A
T43RTN-1190A	T53RTN-1190A	T63RTN-1190A	T73RTN-1190A
T43RTN-3100A	T53RTN-3100A	T63RTN-3100A	T73RTN-3100A
T43RTN-3190A	T53RTN-3190A	T63RTN-3190A	T73RTN-3190A

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5/10/74

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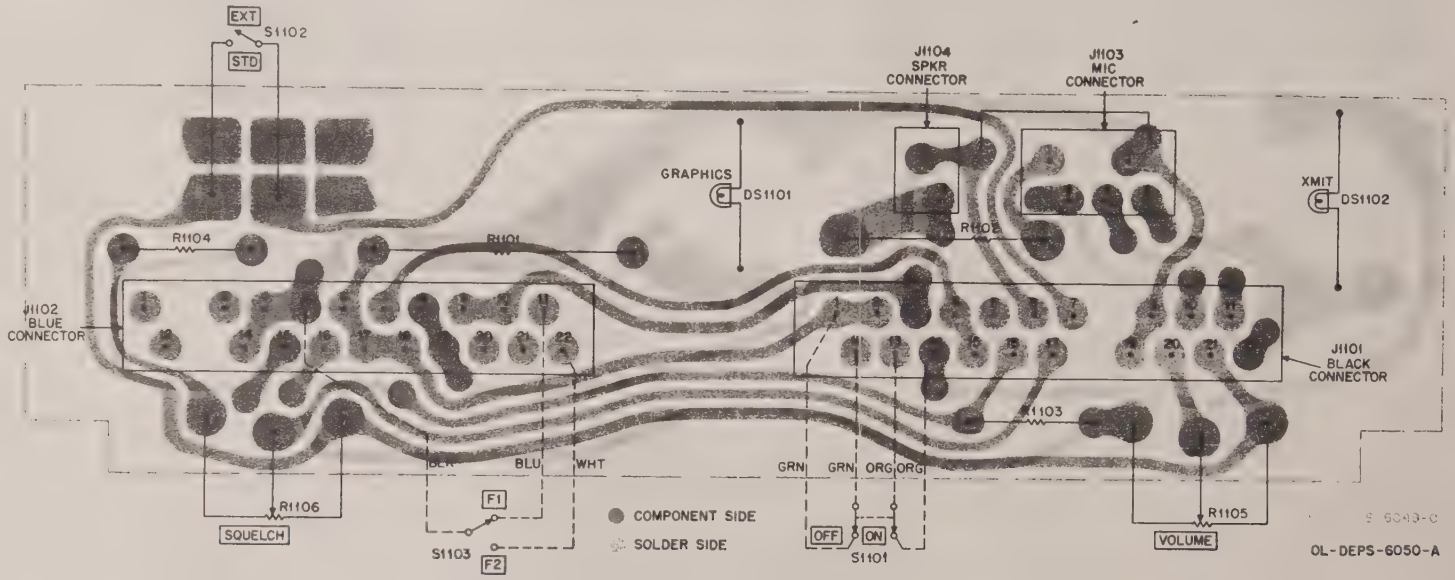
EXT
S1102
STD
J1104
SPKR
CONNECTOR
J1103
MIC
CONNECTOR
GRAPHICS
DS1101
XMIT
DS1102
R1104
R1101
R1102
J1102
BLUE
CONNECTOR
J1101
BLACK
CONNECTOR
R1103
BLK
BLU
WHT
GRN
GRN
ORG
ORG
R1106
SQUELCH
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F2
COMPONENT SIDE
SOLDER SIDE
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ON
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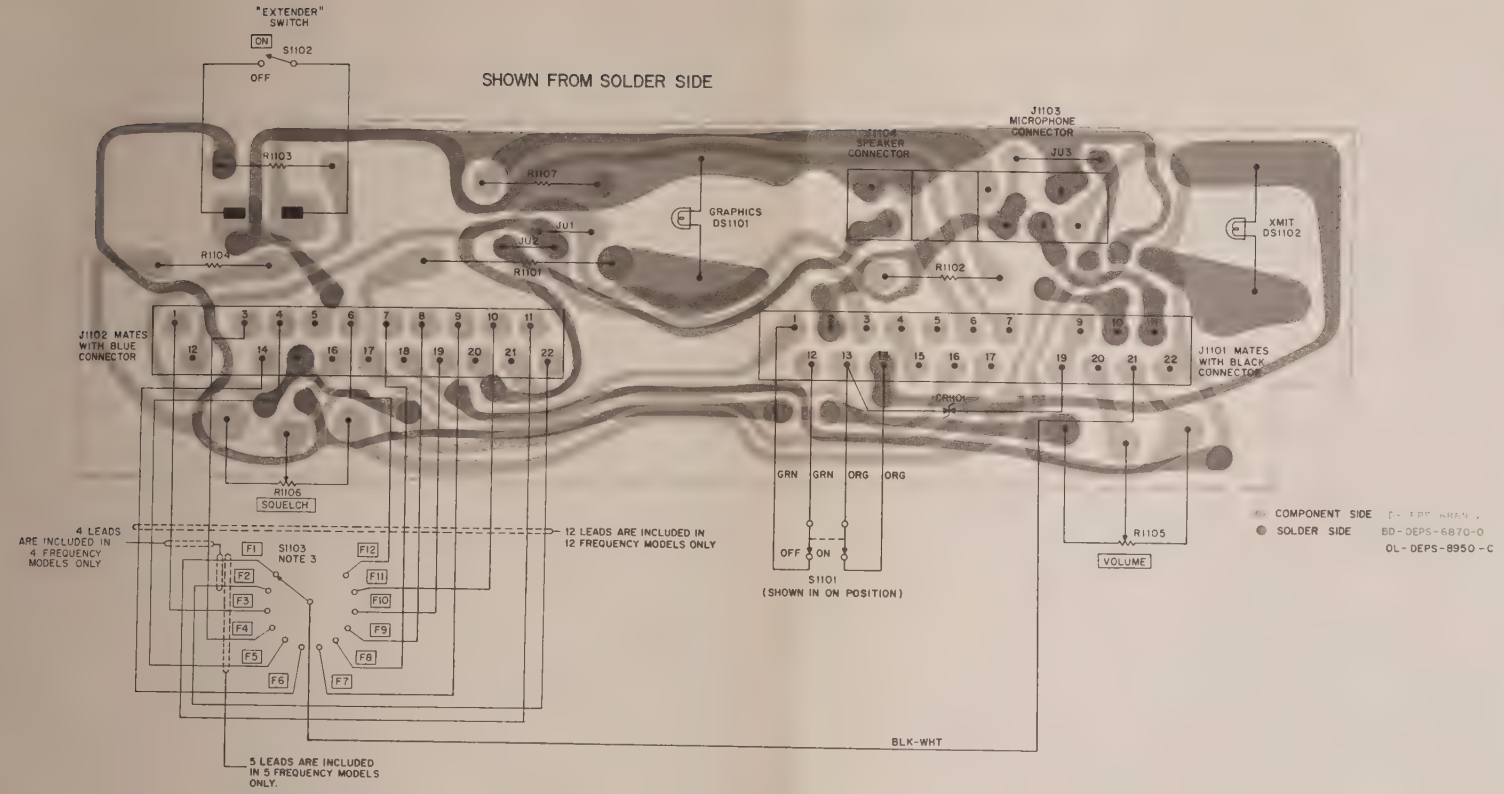
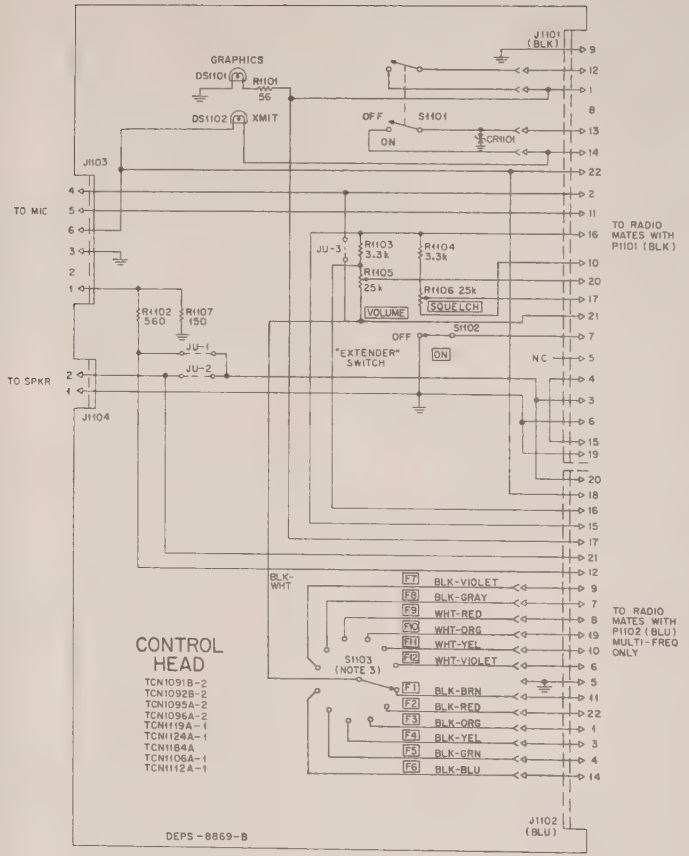
R1105
VOLUME
OL-DEPS-6050-A





NOTES

1. FOR PROPER OPERATION OF THIS CONTROL HEAD WITH HANDSET (TMN6057A) AND HANDSET HANG-UP SWITCH BOX (TLN4504A) REFER TO THEIR RESPECTIVE MANUALS.
2. FOR PROPER OPERATION OF THIS CONTROL HEAD WITH VOICE PRIVACY ADAPTER (TLN1400A) REFER TO VPA MANUAL.
3. S1103 USED ONLY FOR MULTIPLE FREQUENCY CONTROL HEADS:
   POSITIONS 1–4 WIRED FOR 4 FREQUENCY MODELS
   POSITIONS 1–5 WIRED FOR 5 FREQUENCY MODELS
   POSITIONS 1–8 WIRED FOR 8 FREQUENCY MODELS
   POSITIONS 1–12 WIRED FOR 12 FREQUENCY MODELS

EPS-8944-A

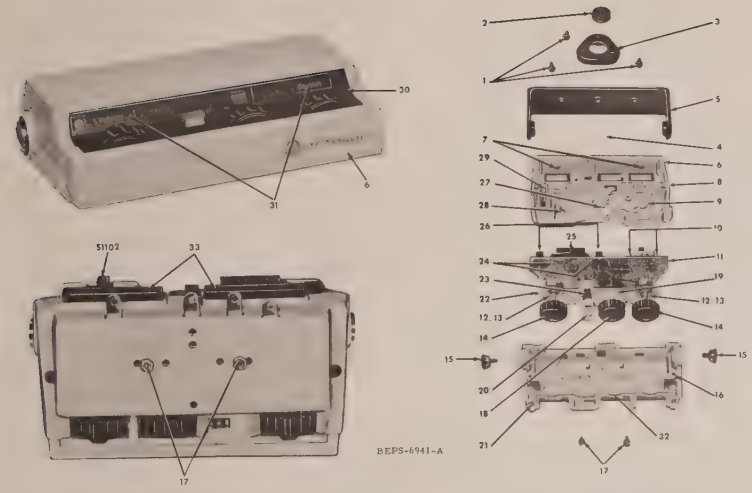
REVISIONS

63P81019E29-D

CHASSIS AND SUFFIX NO.	REF SYMBOL	CHANGE	LOCATION
TCN1091B-2 TCN1092B-2 TCN1095A-2 TCN1096A-2 TCN1119A-1 TCN1124A-1	CR1101	ADDED 48D8[illegible]E45	S1101
		ADDED BLK/WHT LEAD BETWEEN R1105 and S1101	
TCN1184A		ADDED MODEL	SCHEMATIC DIAGRAM AND PARTS LIST

CONTROL HEAD

Control Head Schematic Diagram and Circuit Board Detail
Motorola No. 63P81019E29-D
5/10/76-NPC



MECHANICAL PARTS LIST

IMPORTANT

USE ONLY THE FOLLOWING MOTOROLA PART NUMBERS WHEN ORDERING REPLACEMENT PARTS

CONTROL HEAT MODELS

TCN1091B (Single-Freq.)	TCN1106A (8-Freq.)
TCN1092B (4-Freq.)	TCN1112A (8-Freq.)
TCN1095A (Single-Freq.)	TCN1119A (12-Freq.)
TCN1096I (4-Freq.)	TCN1124A (12-Freq.)
	TCN1184A (5-Freq.)

PL-1048-I

CODE NUMBER	MOTOROLA PART NO.	DESCRIPTION
1	3S136756	SCREW, tapping: 10-16 x 5/8" plain hex flanged head; does not include 4S7652 LOCKWASHER; No. 10 external
2	49C84961C01	DISC, trunnion bracket mounting; "breakaway" type (TCN1091B and TCN1092B)
3	42D84963C01	COLLAR, trunnion bracket mounting (TCN1091B, TCN1092B)
4	3S115727	LOCKSCREW, machine: 10-32 x 1/2" plain hex head (TCN1091B, TCN1092B)
5	7C84576B01	BRACKET, trunnion (TCN1091B, TCN1092B)
6	75B84628B01	FRONT COVER, housing ("bumper")
7	3S136963	SCREW, tapping: 6-20 x 5/16" "Phillips" flat head
8	1V80712B88	TOP COVER ASSEMBLY, housing; includes items coded 6, 7, 9, 27, 28, 29, 31 (multi-freq. models)
	or	
	1V80757B65	TOP COVER ASSEMBLY, housing; includes items coded 6, 7, 9, 28, 29 and 31 (single-freq. models)
9		PRISM, optical (SEE NOTE)
10	3S129675	LOCKSCREW, 4-40 x 1/4" "Phillips" binder head with lockwasher
11	TLN4369B	PLATED CIRCUIT BOARD ASSEMBLY; includes contact terminals
12	2S136272	NUT, machine; 3/8-32 x 1/2" hex
13	4S8210	WASHER, metallic; 0.39" x 0.562" x 0.16"
14	36D84001C02	KNOB, control (volume & squelch)
15	3B84546B01	SCREW, machine; shoulder type (trunnion-mount)
16	3B84548B01	SCREW, machine; 6-32 x 1/2" "Phillips" round head; "captive" type
17	3S136138	LOCKSCREW, machine; 6-32 x 5/8" "Phillips" hex head
18	36D84001C01	KNOB, control; (freq. selector) (requires use of item coded 19)
19	36D84006C01	DISC, switch position indicator (used with item coded 18)
20	45C84004C01	ACTUATOR, switch
21	15E84920B01	HOUSING, (bottom section)
22	7C84005C01	BRACKET (chassis)
23	1V80712B89	SWITCH ASSEMBLY: (slide switch); includes wires, contact terminals and mounting screws
24	3S135084	LOCKSCREW, tapping; 4-40 x 5/16" "Phillips" fillister head
25	42D84067C01	RETAINER, connector
26	9B84627B01	LAMPHOLDER
27, 28		PRISM, optical (SEE NOTE)
29		PRISM, optical; includes RED LENS (SEE NOTE)
30	13D84000C02	BEZEL (single-frequency)
	or 13D84000C01	BEZEL (multi-frequency)
31	33C84038C01	MARKER STRIP (VOLUME, SQUELCH)
32	38B84357C01	PLUG, SNAP-IN (single-freq.)
33	42C84962C01	RETAINER, connector

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		NON-CODED ITEM
	54B84111D01	MOUNTING TEMPLATE (TCN1091B, TCN1092B)

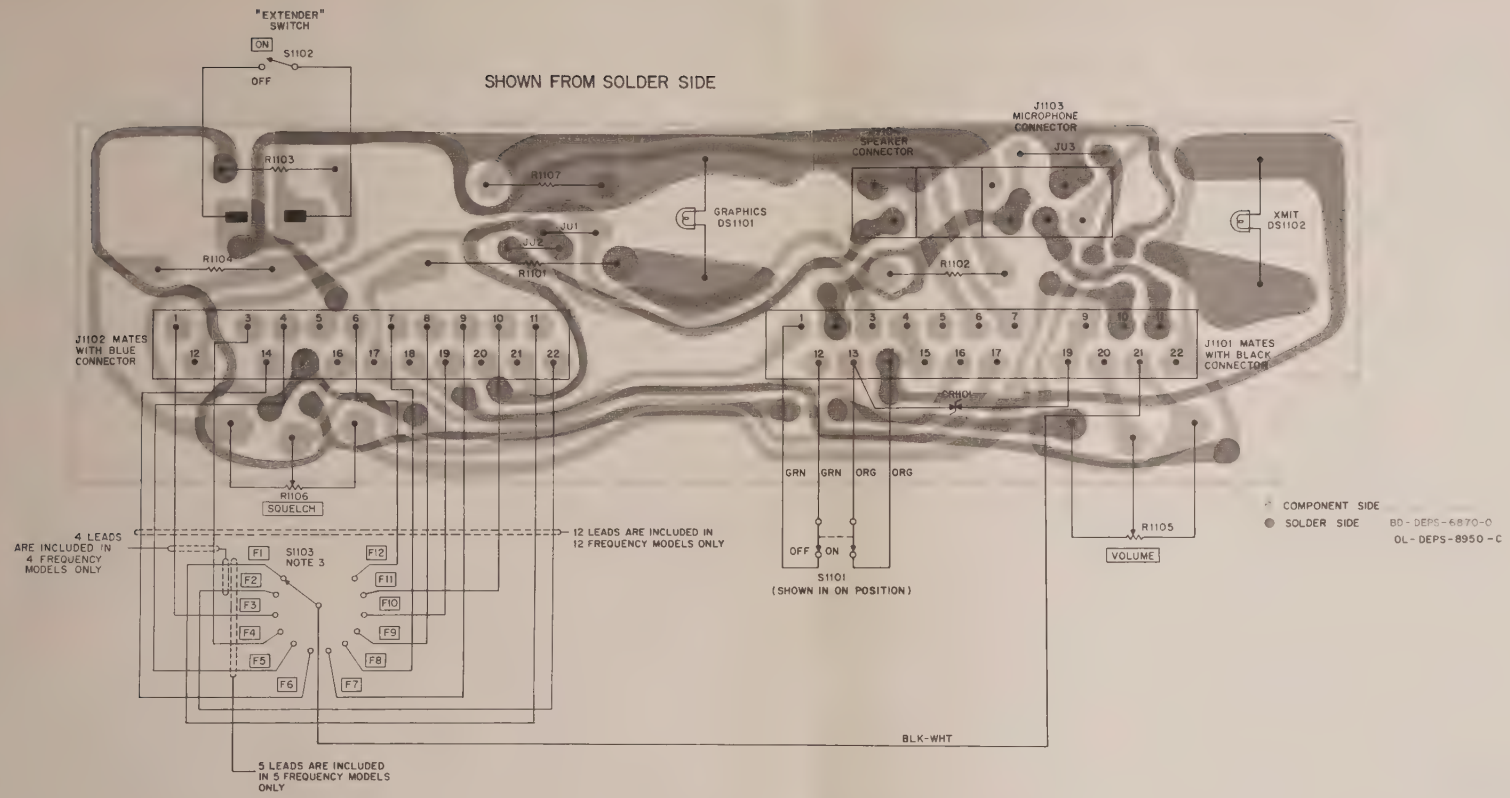
NOTE: Items coded 9, 27, 28 and 29 are not individually replaceable. For field-replacement, order item No. 8 (TOP COVER ASSEMBLY).

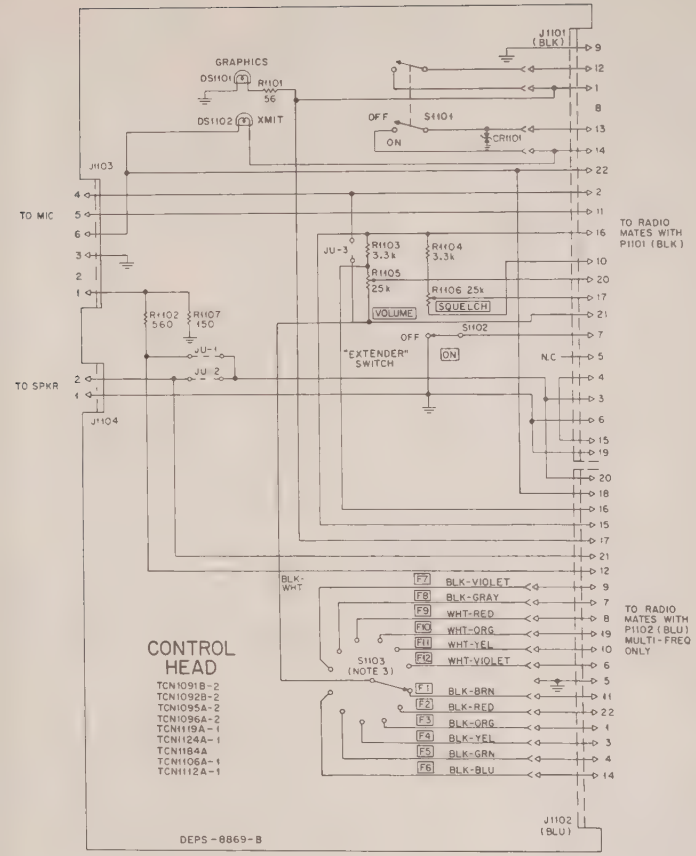
ELECTRICAL PARTS LIST

PL-1049-F

CR1101	48D83461E45	DIODE: SEE NOTE diode; Zener type; nom. 25 V
		LAMP, incandescent: miniature wedge base:
DS1101	65B83554G01	12 V; 0.19 A; type No. 161
DS1102	65B83554G01	12 V; 0.19 A; type No. 161
		CONNECTOR, receptacle:
J1101		c/o (20) 29B84547B01 TERMINALS, pin: male
J1102		c/o (20) 29B84547B01 TERMINALS, pin: male
J1103		c/o (5) 29B84547B01 TERMINALS, pin: male
J1104		c/o (2) 29B84547B01 TERMINALS, pin: male
		RESISTOR:
R1101	6S488090	fixed: 56 ±10%; 2 W
R1102	6S6291	fixed: 560 ±10%; 1/2 W
R1103	6S5581	fixed: 3.3k ±10%; 1/2 W
R1104	6S5581	fixed: 3.3k ±10%; 1/2 W
R1105	18C84584A02	variable: 25k ±30%; 1/4 W
R1106	18C84584A02	variable: 25k ±30%; 1/4 W
R1107	6S6373	fixed: 150 ±10%; 1/2 W
		SWITCH:
S1101	40C84622B02	slide: dpst; does not include 29S10134A86 LUG, connector: female; 4 required
S1102	40C84301C02	momentary slide; spst
S1103	40C84149C01	rotary; 4-position; non-shorting adjustable limiting stop
	40C84149C02	rotary: 8-position; non-shorting adjustable limiting stop
	40C84149C03	rotary: 12 position; non-shorting
		NON-REFERENCED ITEMS
	TLN4369B	PRINTED CIRCUIT BOARD ASSEMBLY: includes 29B84547B01 TERMINAL, contact; male; 47 required 42C84962C01 RETAINER, connector; 2 required

NOTE:
Replacement diodes must be ordered by Motorola part number only for optimum performance.





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   POSITIONS 1-5 WIRED FOR 5 FREQUENCY MODELS
   POSITIONS 1-8 WIRED FOR 8 FREQUENCY MODELS
   POSITIONS 1-12 WIRED FOR 12 FREQUENCY MODELS

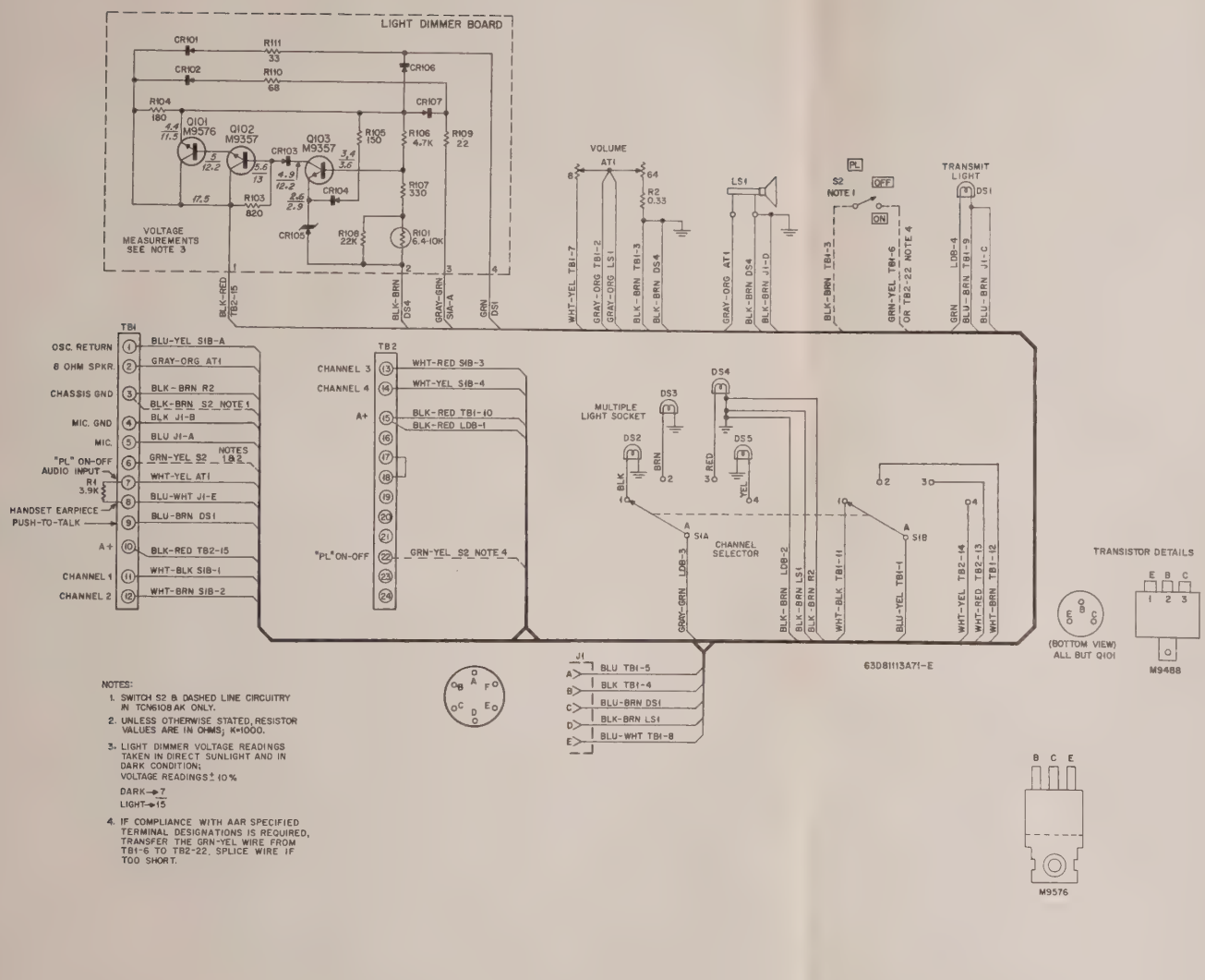
EPS-6944-A

REVISIONS

63P81019E29-D

CHASSIS AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
TCN1091B-2	CR1131	ADDED DIODE E45	S1101
TCN1092B-2		ADDED BLK/WHT	
TCN1095A-2		LEAD BETWEEN	
TCN1096A-2		R1105 and S1103	
TCN1119A-1			
TCN1124A-1			
TCN1184A		ADDED MODEL	SCHEMATIC DIAGRAM AND PARTS LIST

Control Head Schematic Diagram and Circuit Board Detail
Motorola No. 63P81019E29-D
5/10/76-NPC



NOTES:

1. SWITCH S2 B DASHED LINE CIRCUITRY IN TCN6108AK ONLY.
2. UNLESS OTHERWISE STATED, RESISTOR VALUES ARE IN OHMS; K=1000.
3. LIGHT DIMMER VOLTAGE READINGS TAKEN IN DIRECT SUNLIGHT AND IN DARK CONDITION; VOLTAGE READINGS ± 10%
   DARK → 7
   LIGHT → 15
4. IF COMPLIANCE WITH AAR SPECIFIED TERMINAL DESIGNATIONS IS REQUIRED, TRANSFER THE GRN-YEL WIRE FROM TB1-6 TO TB2-22. SPLICE WIRE IF TOO SHORT.

PARTS LIST

N6108AJ, BJ Control Head & Speaker, 4-freq., [illegible] rting, carrier squelch, w/dimmer
[illegible], [illegible] Speaker, 4-freq., [illegible] quelch, w/dimmer EPD-17238-F

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		ATTENUATOR, AF: "L" pad; [illegible]
AT1	18C82744G01	[illegible]
AT1A		8 ohms ±10%; (front)
AT1B		64 ohms ±10%; (rear)
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR101, 102, 106, 107	48C82466H01	[illegible]
CR103, 104	48C82392B03	silicon
CR105	48D82256G33	silicon; zener; 2.7 v
		LAMP, incandescent:
DS1, 2, 3, 4, 5	65R4151	6-8 v; 0.2 a; min. bay; type 51
		CONNECTOR, [illegible]
J1	9C848764	[illegible]
		LOUDSPEAKER, permanent magnet:
LS1	50D82731G01	5"; round; 8 ohm imp. 15 weather-resistant
		TRANSISTOR: (SEE NOTE)
Q101	48R869576	N-P-N; type M9576
Q102, 103	48R869357	N-P-N; type M9357
		RESISTOR, fixed: ±10% [illegible]
R1	[illegible]	[illegible]
R2	17K848766	0.33; 1 w
R101	6C83828D01	light-dependent type; 6.4-10K @ 2 F.C. @ 25°C
R103	6S5701	820; 1 w
R104	17C82036G10	180; 2 w
R105	6S6373	150; 1/2 w
R106	6R3924	4.7K ±5%; 1/2 w
R107	6S6022	330; 1/2 w
R108	6S128685	22K; 1/4 w
R109	[illegible]	[illegible]
R110	[illegible]	[illegible]
R111	[illegible]	[illegible]
		SWITCH
S1	40C82772G01	rotary; 2 pole; 4 position non-shorting
S2	40B858304	toggle dpst (Model TCN6108AK only)
		TERMINAL BOARD:
TB1, 2	31B880805	12 screw terminals
		LIGHT, indicator:
XDS1	60B82197H01	min. bay; incl BLU lens
		LAMPHOLDER ASSEMBLY
XDS2, 3, 4, 5	9B82685G01	min. bay; 4 [illegible]
NON-REFERENCED ITEMS		
	[illegible] 28A82771G01	KNOB, control; 2 req'd PLUG, threaded

NOTE

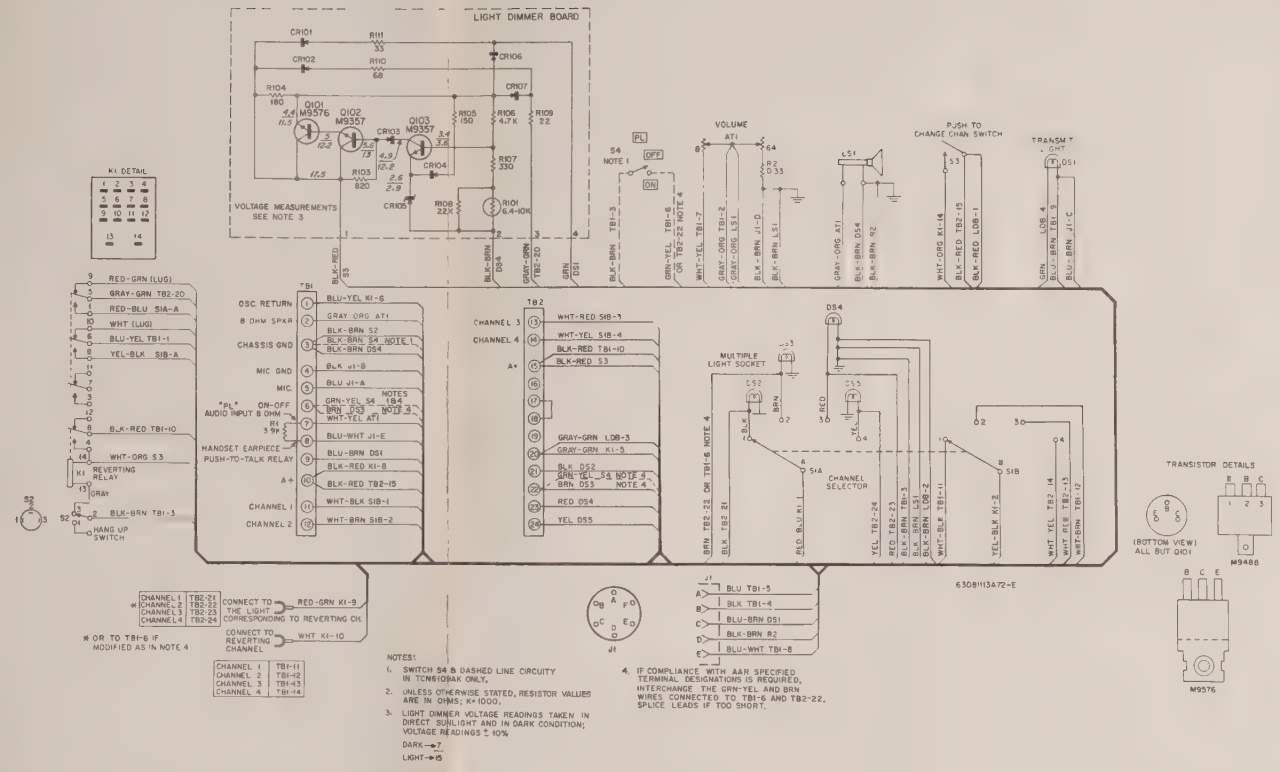
Replacement diodes and transistors must be ordered by Motorola part number only for optimum performance.

Models TCN6108AJ, BJ, and TCN6108AK, BK
Control Head Schematic Diagram
Motorola No. 63P81013E36-A
7/29/74-NPC

PARTS LIST

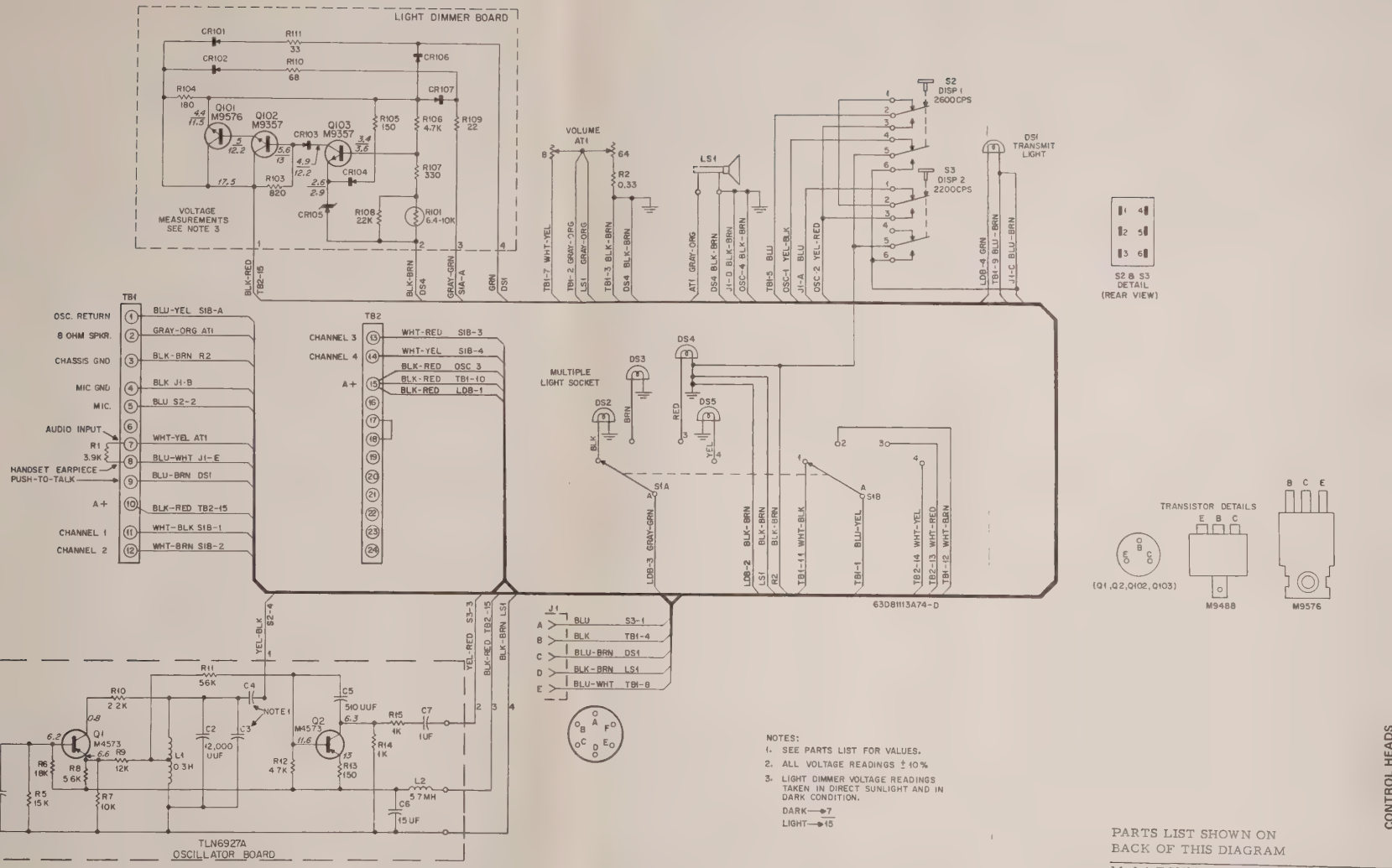
TCN6109AJ, BJ Control Head & Speaker, 4-freq., reverting, carrier squelch, w/dimmer
TCN6109AK, BK Control Head & Speaker, 4-freq., reverting, tone-coded squelch, w/dimmer EPD-17239-E

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		ATTENUATOR, AF: "L" pad: 12 watt:
AT1	18C82744G01	c/o:
AT1A		8 ohms ±10%; (front)
AT1B		64 ohms ±10%; (rear)
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR101, 102, 106, 107	48C82466H01	silicon
CR103, 104	48C82392B03	silicon
CR105	48D82256C33	silicon; zener; 2.7 v
		LAMP, incandescent:
DS1, 2, 3, 4, 5	65R4151	6-8 v; 0.2 a; min. bay; type 51.
		CONNECTOR, receptacle:
J1	9C848764	female; 6 contact
		RELAY, armature:
K1	80D83576E01	4 form "C"; coil resistance: 80 ohms ±10%; @25°C
		LOUDSPEAKER, permanent, magnet:
LS1	50D82731G01	5" round; 8 ohm imp. 15 w; weather-resistant
		TRANSISTOR: (SEE NOTE)
Q101	49R869576	N-P-N, type M9576
Q102, 103	48R869357	N-P-N, type M9357
		RESISTOR, fixed: ±10%
R1	6R5618	3.9K; 1 w
R2	17K848766	0.33; 1 w
R101	6C83828D01	light-dependent type; 6.4-10K @ 2 F.C. @25°C
R103	6S5701	820; 1 w
R104	17C82036G10	180; 2 w
R105	6S6373	150; 1/2 w
R106	6R3924	4.7K ±5%; 1/2 w
R107	6S6022	330; 1/2 w
R108	6S128685	22K; 1/4 w
R109	6R488026	22; 1 w
R110	17C82036G01	68; 2 w
R111	17C82036G11	33; 2 w
		SWITCH
S1	40C82772G01	rotary; 2 pole; 4 position; non-shorting
S2	40B82737G02	push; spdt
S3	40A881084	push; spst-normally open
S4	40B858304	toggle: dpst (Model TCN6109AK only)
		TERMINAL BOARD:
TB1, 2	31B880805	15 screw terminals
		LIGHT, indicator:
XDS1	60B82197H01	min. bay; incl BLU lens
		LAMPHOLDER ASSEMBLY:
XDS2, 3, 4, 5	9B82685G01	min. bay 4 section
NON-REFERENCED ITEM		
	36C82632H02	KNOB, control; 2 req'd



NOTES:
1. SWITCH S4 & DASHED LINE CIRCUITRY IN TCN6109AK ONLY.
2. UNLESS OTHERWISE STATED, RESISTOR VALUES ARE IN OHMS; K=1000.
3. LIGHT DIMMER VOLTAGE READINGS TAKEN IN DIRECT SUNLIGHT AND IN DARK CONDITION; VOLTAGE READINGS ± 10%
   DARK → 7
   LIGHT → 15
4. IF COMPLIANCE WITH AAR SPECIFIED TERMINAL DESIGNATIONS IS REQUIRED, INTERCHANGE THE GRN-YEL AND BRN WIRES CONNECTED TO TB1-6 AND TB2-22. SPLICE LEADS IF TOO SHORT.

Models TCN6109AJ, BJ and TCN6109AK, BK
Control Head Schematic Diagram
Motorola No. 63P81013E37-A
7/29/74-NPC



PARTS LIST SHOWN ON
BACK OF THIS DIAGRAM

Model TCN1057AJ, BJ Control Head
Schematic Diagram
Motorola No. 63P81013E39-A
7/29/74-NPC

CONTROL HEADS

PARTS LIST

TCN6110AJ Control Head, with Dimmer — EPD-17236-C

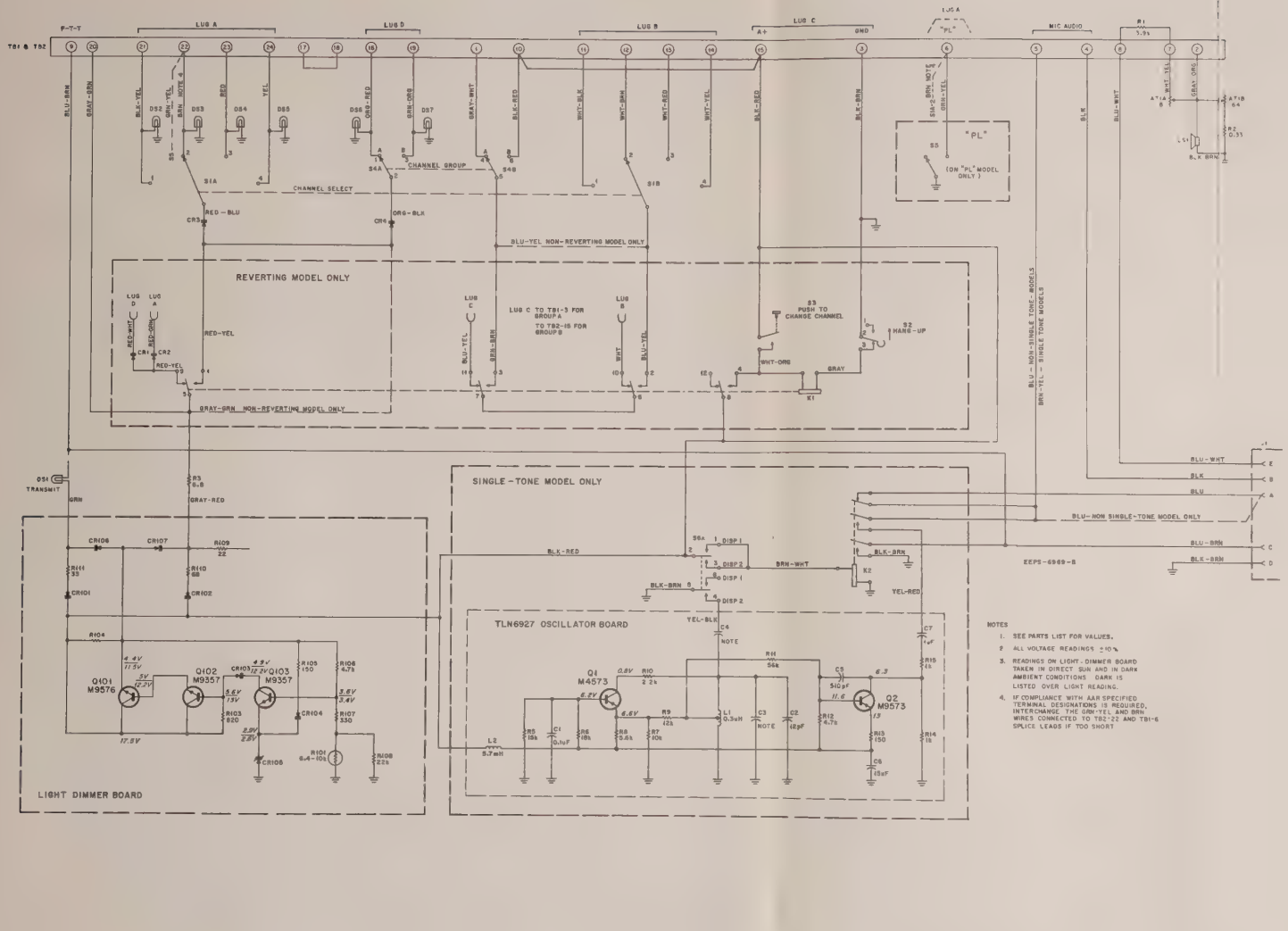
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		ATTENUATOR: AF: "L" pad; 12 watt:
AT1	18C82744G01	c/o:
AT1A		8 ohms ±10% (front)
AT1B		64 ohms ±10% (rear)
		SEMICONDUCTOR DEVICE diode (SEE NOTE)
CR101, 102, 106, 107	48C82466H01	silicon
CR103, 104	48C82392B03	silicon
CR105	48D82256C33	silicon; zener; 2.7 v
		LAMP, incandescent:
DS1, 2, 3, 4, 5	65R4151	6-8 v; 0.2 a; min. bay. type 51
		CONNECTOR, receptacle:
J1	9C848764	female; 6 contact
		LOUDSPEAKER, permanent magnet:
LS1	50D82731G01	5"; round; 8 ohm imp. 15 w; weather-resistant
		TRANSISTOR: (SEE NOTE)
Q101	48R869576	N-P-N; type M9576
Q102, 103	48R869357	N-P-N; type M9357
		RESISTOR: fixed: ±10%
R1	6R5618	3.9K; 1 w
R2	17K848766	0.33; 1 w
R101	6C83828D01	light-dependent type; 6.4-10K @ 2 F.C. @25°C
R103	6S5701	820; 1 w
R104	17C82036G10	180; 2 w
R105	6S6373	150; 1/2 w
R106	6R3924	4.7K ±5%; 1/2 w
R107	6S6022	330; 1/2 w
R108	6S128685	22K; 1/4 w
R109	6R488026	22; 1 w
R110	17C82036G01	68; 2 w
R111	17C82036G11	33; 2 w
		SWITCH,
S1	40C82772G01	rotary; 2 pole; 4 position non-shorting
S2, 3	40C83098A01	push; dpdt
		TERMINAL BOARD:
TB1, 2	31B880805	12 screw terminals
		LIGHT, indicator:
XDS1	60B82197H01	min. bay; incl BLU lens
		LAMPHOLDER ASSEMBLY:
XDS2, 3, 4, 5	9B82685G01	min. bay; 4 section
NON-REFERENCED ITEMS		
	36C82632H02	KNOB, control; 2 req'd
	28A82771G01	PLUG, threaded
	3A822Z7A03	SCREW, special (4-40-5/16") 4 req'd

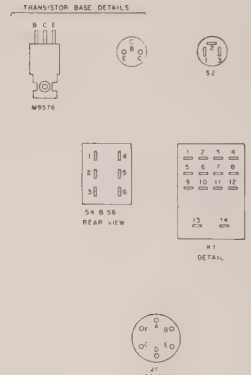
TLN6927A Oscillator Board — EPD-17237-B

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed: uf ±10%; unless stated
C1	8D82905G22	.10; 100 v
C2	21K865815	12000 uuf ±1%; 500 v
C3, 4		(factory-selected; see following list)
	21D84494B24	39 uuf ±5%; 500 v
	or21D84494B31	75 uuf ±5%; 500 v
	or21D84494B07	150 uuf ±5%; 500 v
	or21D84494B14	270 uuf ±5%; 500 v
	or21K848158	390 uuf; 300 v
	or21K845214	510 uuf ±5%; 300 v
	or21K848236	650 uuf ±5%; 300 v
	or21K863298	5000 uuf ±1%; 500 v
C5	21K845214	510 uuf ±5%; 300 v
C6	23C82013C01	15-10+100%; 25 v
C7	8K863306	1; 200 v
		COIL, RF:
L1	24C813452	toroid filter; .3 uh
L2	24K864763	choke; 5.7 uh
		TRANSISTOR: (SEE NOTE)
Q1, 2	48R134573	P-N-P; type M4573
		RESISTOR, fixed: ±10%; 1/2 w unless stated
R5	6S6477	15K
R6	6S488095	18K ±5%
R7	6S5556	10K ±5%
R8	6S3940	5.6K ±5%
R9	6S6394	12K
R10	6S6069	2.2K
R11	6S6378	56K
R12	6S6080	4.7K
R13	6S6373	150
R14, 15	6S6229	1K

NOTE:

Replacement diodes and transistors must be ordered by Motorola part number only for optimum performance.





NOTES

1. SEE PARTS LIST FOR VALUES.
2. ALL VOLTAGE READINGS ±10%.
3. READINGS ON LIGHT-DIMMER BOARD TAKEN IN DIRECT SUN AND IN DARK AMBIENT CONDITIONS. DARK IS LISTED OVER LIGHT READING.
4. IF COMPLIANCE WITH AAR SPECIFIED TERMINAL DESIGNATIONS IS REQUIRED, INTERCHANGE THE GRN-YEL AND BRN WIRES CONNECTED TO TB2-22 AND TB1-6 SPLICE LEADS IF TOO SHORT.

PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

Eight-Channel Control Heads
Schematic Diagram
Motorola No. 63P81013E38-B
7/29/74-NPC

PARTS LIST

IMPORTANT

USE ONLY THE FOLLOWING MOTOROLA PART NUMBERS WHEN ORDERING REPLACEMENT PARTS

8-FREQUENCY CONTROL HEADS WITH "DIMMER"

TCN6146A (Carrier Squelch)
TCN6147A ("Private-Line")
TCN6148A (Carrier Squelch with Reverting)
TCN1099A (Carrier Squelch with "Single-Tone")

PL-1317-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		ATTENUATOR, AF:
AT1	18-82744G01	"L" pad: 12-watt: consists of:
AT1A		8 ohms ±10% (front section)
AT1B		64 ohms ±10% (rear section)
		CAPACITOR, fixed: pF: ±10%, 300 V; unless otherwise stated
C1	8-82905C22	0.1 uF; 100 V
C2	21-865815	.012 uF ±10%; 500 V
C3, 4		(selected according to frequency from values listed below):
	21-863298	5000 ±1%; 500 V
	21-848158	390
	21-845214	510 ±5%
	21-848236	650 ±5%
	21-84494B24	39 ±5%; 500 V
	21-84494B31	75 ±5%; 500 V
	21-84494B07	150 ±5%; 500 V
	21-84494B14	270 ±5%; 500 V
C5	21-845214	510 ±5%
C6	23-82013C01	15 uF +100-10%; 25 V
C7	8-863306	1 uF ; 200 V
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR1 thru CR4	48-82466H12	silicon
CR101	48-82466H13	silicon
CR102	48-82466H13	silicon
CR103	48-82392B03	silicon
CR104	48-82392B03	silicon
CR105	48-82256C33	zener: 2.7 V ±5%
CR106 thru CR111	48-82466H13	silicon
DS1 thru DS7	1-4151	LAMP, incandescent: miniature bayonet; 6-8 V; 0.2 A; type No. 51
J1	9-848764	CONNECTOR, receptacle: female; 6-contact
K1	80-83576E01	RELAY, armature: 4 form "C"; coil res 80 ohms ±10%
L2	80-84157B02	SWITCH, magnetic reed: 2 form "A", 1 form "B"; 2 coil; resistance of each coil 285 ohms ±10%
L1	24-813452	COIL, AF: toroidal type; tapped; 0.3 uH
L2	24-864763	COIL, RF: choke; 5.7 uH
LS1	50-82731G01	LOUDSPEAKER, permanent magnet: 5"; "pincushion" type; 15 ohms impedance; weather-resistant

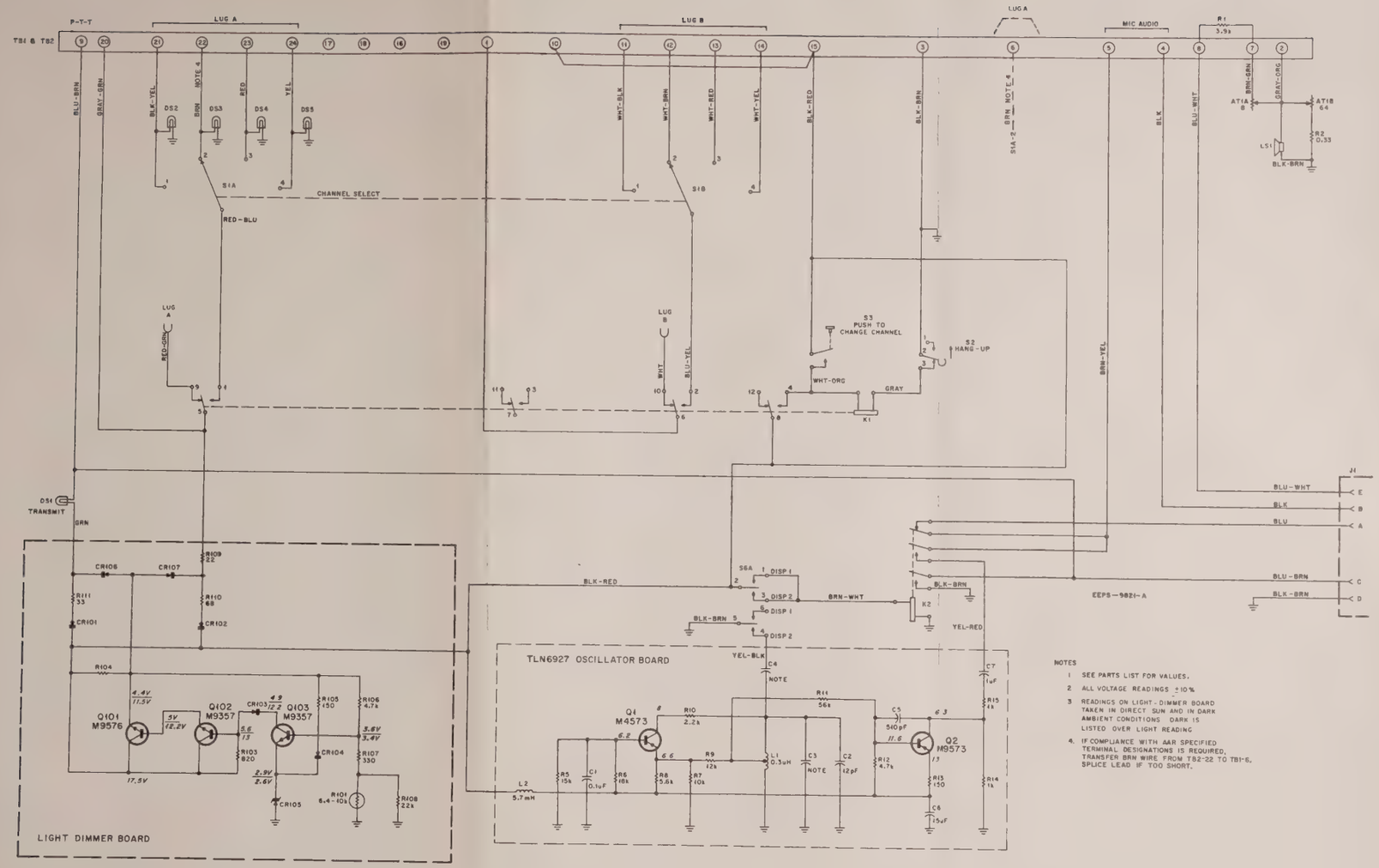
REFERENCE SYMBOL	MOTOROLA PART NO	DESCRIPTION
		TRANSISTOR: (SEE NOTE)
Q1	48-134573	P-N-P: type M4573
Q2	48-134573	P-N-P: type M4573
Q101	48-869576	N-P-N: type M9576
Q102	48-869357	N-P-N: type M9357
Q103	48-869357	N-P-N: type M9357
		RESISTOR, fixed: ±10%; 1/2 W; unless otherwise stated
R1	6-5618	3.9k ; W
R2	17-848766	0.33 ; W
R3	6-126D65	6.8 1 W
R4		NOT USED
R5	6-6477	15k
R6	6-488095	18k ±5%
R7	6-5556	10k ±5%
R8	6-3940	5.6k ±5%
R9	6-6394	12k
R10	6-6069	2.2k
R11	6-6378	5.6
R12	6-6080	4.7k
R13	6-6373	15k
R14	6-6229	1k
R15	6-6229	1k
R101	6-83828D01	photo-resistive cell: 6.4k -10k @ 2 F.C. @ 25°C: max. allowable applied potential 60 V; max. allowable current 40 mA
R102		NOT USED
R103	6-5701	820; 1 W
R104	17-82036G10	180; 2 W
R105	6-6373	150
R106	6-3924	4.7k ±5%
R107	6-6022	330
R108	6-128685	22k; 1/4 W
R109	6-488026	22; 1 W
R110	17-82036G01	68; 2 W
R111	17-82036G11	33; 2 W
		SWITCH:
S1	40-82772G01	rotary: 2-pole; 4-position; non-shorting
S2	40-82737G02	push: spdt
S3	40-881084	push: spst
S4	40-811751	toggle: dpdt
S5	40-858304	toggle: dpst
S6	40-83568D02	toggle: dpdt; momentary; center return ("off")
		TERMINAL BOARD:
TB1	31-880805	12 dual screw terminals
TB2	31-880805	12 dual screw terminals
		LIGHT, indicator:
XDS1	60-82197H01	miniature bayonet type; includes BLU lens
		LAMPHOLDER ASSEMBLY:
XDS2 thru XDS5	9-82685G01	includes 4 miniature bayonet type lampholders
XDS6	9-84325D01	includes 2 miniature bayonet type lampholders
XDS7	9-84325D01	includes 2 miniature bayonet type lampholders

NON-REFERENCED ITEMS

	13-84298D02	ESCUTCHEON (TCN6146A)
	13-84298D05	ESCUTCHEON (TCN6147A)
	13-84298D03	ESCUTCHEON (TCN6148A)
	13-84298D01	ESCUTCHEON (TCN1099A)
	34-84300D01	DISPLAY SCREEN, channel switch position indicator
	42-861179	CLAMP, cable
	35-83628E01	CLOTH, speaker grille
	13-84301D01	GRILLE, speaker
	43-82183H01	PLUNGER, handset hang-up
	41-82184H01	SPRING, plunger
	64-82185H01	BRACKET, plunger spring retaining
	29-3036	LUG, soldering
	26-83806D02	SHIELD, light diffusing
	28-82771G01	PLUG, threaded; special type (non-"reverting" models)
	33-82730G01	NAMEPLATE
	36-82632H02	KNOB, control
	64-83293G01	BRACKET, knob rotation limiting
	3-134184	SCREW, tapping: 4-40 x 5/16" Phillips hex head (int. lock-washer)
	3-134185	SCREW, tapping: 6-32 x 1/4" Phillips hex head (ext. lock-washer)
	3-134186	SCREW, tapping: 6-32 x 5/16" Phillips hex head (ext. lock-washer)
	3-134168	SCREW, tapping: 4-40 x 1/4" Phillips hex head (int. lock-washer)
	3-135664	SCREW, machine: 6-32 x 9/16" Phillips hex head (ext. lock-washer)
	3-136138	SCREW, machine: 6-32 x 3/8" Phillips hex head (int. lock-washer)
	3-136140	SCREW, machine: 8-32 x 5/8" Phillips hex head (ext. lock-washer)
	3-136141	SCREW, machine: 8-32 x 11/16" Phillips hex head (ext. lock-washer)
	3-12927b	SCREW, machine: 10-32 x 1-1/4" Phillips oval head
	15-83290G03	HOUSING ASSEMBLY; incls: 55-82686G01 HINGE; 15-82188H01 COVER, entrance hole; 42-82192H01 BAR, cover retainer; 4-7671 LOCKWASHER· No. 8 split; 2-800328 NUT, machine: knurled; 3-136137 SCREW, tapping: 6-32 x 5/16" slotted pan head (ext. lockwasher)
	1-80735A64	WIRE TERMINATION KIT: incls: 29-5238 LUG, soldering: quantity of 16 supplied; 37-61348 SLEEVE, rubber: quantity of 16 supplied
	84-84321D01	DIODE BOARD, lamp isolation
	64-84355D01	BRACKET, diode board mounting
	75-8228.H02	PAD, handset hang-up cushioning (top)
	75-82281H03	PAD, handset hang-up cushioning (bottom)

NOTE:

Replacement diodes and transistors must be ordered by Motorola part number only for optimum performance.



NOTES

1. SEE PARTS LIST FOR VALUES.
2. ALL VOLTAGE READINGS ±10%
3. READINGS ON LIGHT-DIMMER BOARD TAKEN IN DIRECT SUN AND IN DARK AMBIENT CONDITIONS. DARK IS LISTED OVER LIGHT READING
4. IF COMPLIANCE WITH AAR SPECIFIED TERMINAL DESIGNATIONS IS REQUIRED, TRANSFER BRN WIRE FROM TB2-22 TO TB1-6, SPLICE LEAD IF TOO SHORT.

PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

Model TCN1100A
Eight-Channel Control Head
Schematic Diagram
Motorola No. 63P81017E99-A
7/29/74-NPC

PARTS LIST

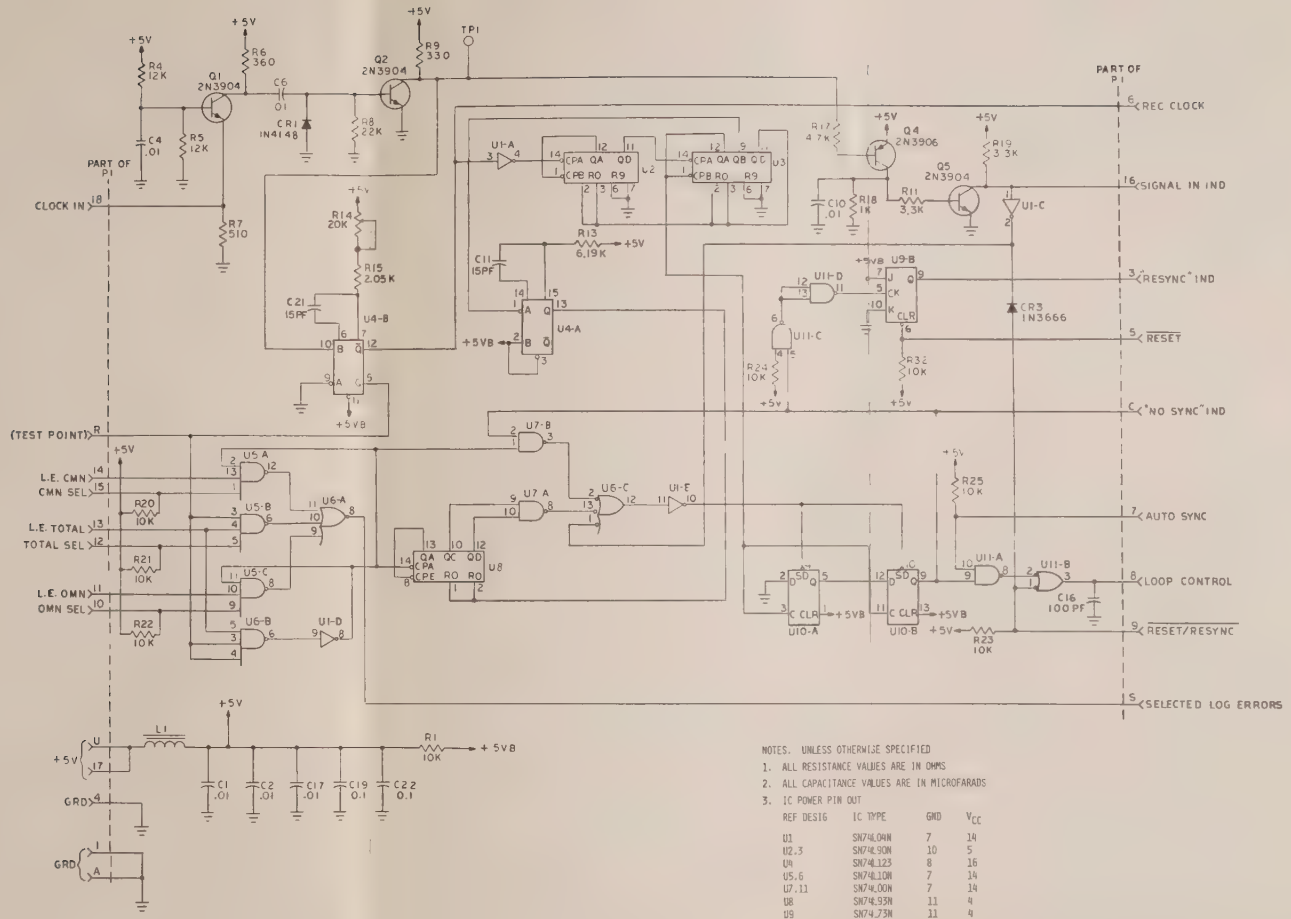
TCN1100A Control Head (Single-Tone Reverting)
TCN6149A Control Head Chassis PL-1990-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		ATTENUATOR, AF:
AT1	18-82744G01	"L" pad; 12-watt, consists of:
AT1A		8 ohms ±10% (front section)
AT1B		64 ohms ±10% (rear section)
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR101	48-82466H13	silicon
CR102	48-82466H13	silicon
CR103	48-82392B03	silicon
CR104	48-82392B03	silicon
CR105	48-82256C31	Zener; 2.7 V ±5%
CR106, 107	48-82466H13	silicon
		LAMP, incandescent:
DS1 thru DS5	6-4151	miniature bayonet; 6-8 V; 0.2 A, type No. 51
		CONNECTOR, receptacle
J1	9-848764	female; 6-contact
		RELAY, armature:
K1	80-83576E01	4 form "C"; coil res 80 ohms ±10%
		SWITCH, magnetic reed:
K2	80-84157B02	2 form "A", 1 form "B"; 2 coil; resistance of each coil 285 ohms ±10%
		COIL, AF:
L1	24-813452	toroidal type; tapped: 0.3 uH
		COIL, RF:
L2	24-864763	choke; 5.7 uH
		LOUDSPEAKER, permanent magnet:
LS1	50-82731G01	5", "pincushion" type; 15 ohms impedance; weather-resistant
		TRANSISTOR: (SEE NOTE)
Q101	48-869576	N-P-N; type M9576
Q102	48-869357	N-P-N; type M9357
Q103	48-869357	N-P-N; type M9357
		RESISTOR, fixed: ±10% 1/2 W; unless otherwise stated
R1	6-5618	3.9k; 1 W
R2	17-848766	0.33; 1 W
R103	6-5701	820; 1 W
R104	17-82036G10	180; 2 W
R105	6-6173	150
R106	6-3924	4.7k ±5%
R107	6-6022	330
R108	6-128685	22k; 1/4 W
R109	6-488026	22; 1 W
R110	17-82036G01	68; 2 W
R111	17-82036G11	33; 2 W
		SWITCH:
S1	40-82772G01	rotary; 2-pole; 4-position; non-shorting
S2	40-82737G02	push; spdt
S3	40-881084	push; spst
S6	40-83568D02	toggle; dpdt; momentary; center return ("off")
		TERMINAL BOARD:
TB1	31-880805	12 dual screw terminals
TB2	31-880805	12 dual screw terminals
		LIGHT, indicator:
XDS1	60-82197H01	miniature bayonet type: includes BLU lens
		LAMPHOLDER ASSEMBLY:
XDS2 thru XDS5	9-82685G01	includes 4 minature bayonet type lampholders

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		NON-REFERENCED ITEMS
	13-84298D04	ESCUTCHEON
	34-84300D01	DISPLAY SCREEN, channel switch position indicator
	42-861179	CLAMP, cable
	35-83628E01	CLOTH, speaker grille
	13-84301D01	GRILLE, speaker
	43-82183H01	PLUNGER, handset hang-up
	41-82184H01	SPRING, plunger
	64-82185H01	BRACKET, plunger spring retaining
	29-3036	LUG, soldering
	26-83806D02	SHIELD, light diffusing
	28-82771G01	PLUG, threaded; special type (non-"reveiling" models)
	33-84326D01	NAMEPLATE
	36-82632H02	KNOB, control
	64-83293G01	BRACKET, knob rotation limiting
	3-134184	SCREW, tapping: 4-40x5/16" Phillips hex head (int. lock-washer)
	3-134185	SCREW, tapping: 6-32x1/4" Phillips hex head (ext. lock-washer)
	3-134186	SCREW, tapping: 6-32x5/16" Phillips hex head (ext. lock-washer)
	3-134168	SCREW, tapping: 4-40x1/4" Phillips hex head (int. lock-washer)
	3-135664	SCREW, machine: 6-32x9/16" Phillips hex head (ext. lock-washer)
	3-136138	SCREW, machine: 6-32x3/8" Phillips hex head (int. lock-washer)
	3-136140	SCREW, machine: 8-32x5/8" Phillips hex head (ext. lock-washer)
	3-136141	SCREW, machine: 8-32x11/16" Phillips hex head (ext. lock-washer)
	3-129276	SCREW, machine: 10-32 x 1-1/4" Phillips oval head
	1-80723B94	HOUSING ASSEMBLY: (riveted)
	1-80735A64	WIRE TERMINATION KIT incls: 29-5238 LUG, soldering: quantity of 16 supplied 37-61348 SLEEVE, rubber: quantity of 16 supplied
	1-80724B42	DIODE BOARD, lamp isolation
	64-84355D01	BRACKET, diode board mounting
	75-82281H02	PAD, handset hang-up cushioning (top) 2 req'd.
	75-84451D01	PAD, handset hang-up cushioning (bottom)
	14B84210A01	INSULATOR, transistor: 2 req'd.
	26-84039E01	HEATSINK
	1-80769A68	LIGHT DIMMER BOARD ASSY. (includes electrical components)
	7-83597E01	BRACKET, dimmer board mtg.
	4-84152B01	WASHER, shoulder; 2 req'd.
	7-82738G01	BRACKET, relay (K1)
	1-80723B95	CABLE ASSY. (laced)

REFERENCE SYMBOL	MOTOROLA PART NO	DESCRIPTION
		TLN6927A Tone Oscillator Board PL-1991-O
		CAPACITOR, fixed: pF; ±10%; 500 V; unless otherwise stated
C1	8-82905G22	0.1 uF; 100 V
C2	21-865815	.012 uF ±10%; 500 V
C3, 4		(selected according to frequency from values listed below):
	21-863298	5000 ±1%; 500 V
	21-848158	390
	21-845214	510 ±5%
	21-848236	650 ±5%
	21-84494B24	39 ±5%; 500 V
	21-84494B31	75 ±5%; 500 V
	21-84494B07	150 ±5%; 500 V
	21-84494B14	270 ±5%; 500 V
C5	21-845214	510 ±5%
C6	23-82013C01	15 uF +100-10%; 25 V
C7	8-863306	1 uF; 200 V
		TRANSISTOR: (SEE NOTE)
Q1	48-134573	P-N-P; type M4573
Q2	48-134573	P-N-P; type M4573
		RESISTOR, fixed: ±10%; 1/2 W; unless otherwise stated
R5	6-6477	15k
R6	6-488095	18k ±5%
R7	6-5556	10k ±5%
R8	6-3940	5.6k ±5%
R9	6-6394	12k
R10	6-6069	2.2k
R11	6-6378	56k
R12	6-6080	4.7k
R13	6-6373	150
R14	6-6229	1k
R15	6-6229	1k
R101	6-83828D01	photo-resistive cell; 6.4k -10k @ 2 F.C. @25°C; max. allowable applied potential 60 V; max. allowable current 40 mA

NOTE:
Replacement diodes and transistors must be ordered by Motorola part number only for optimum performance.

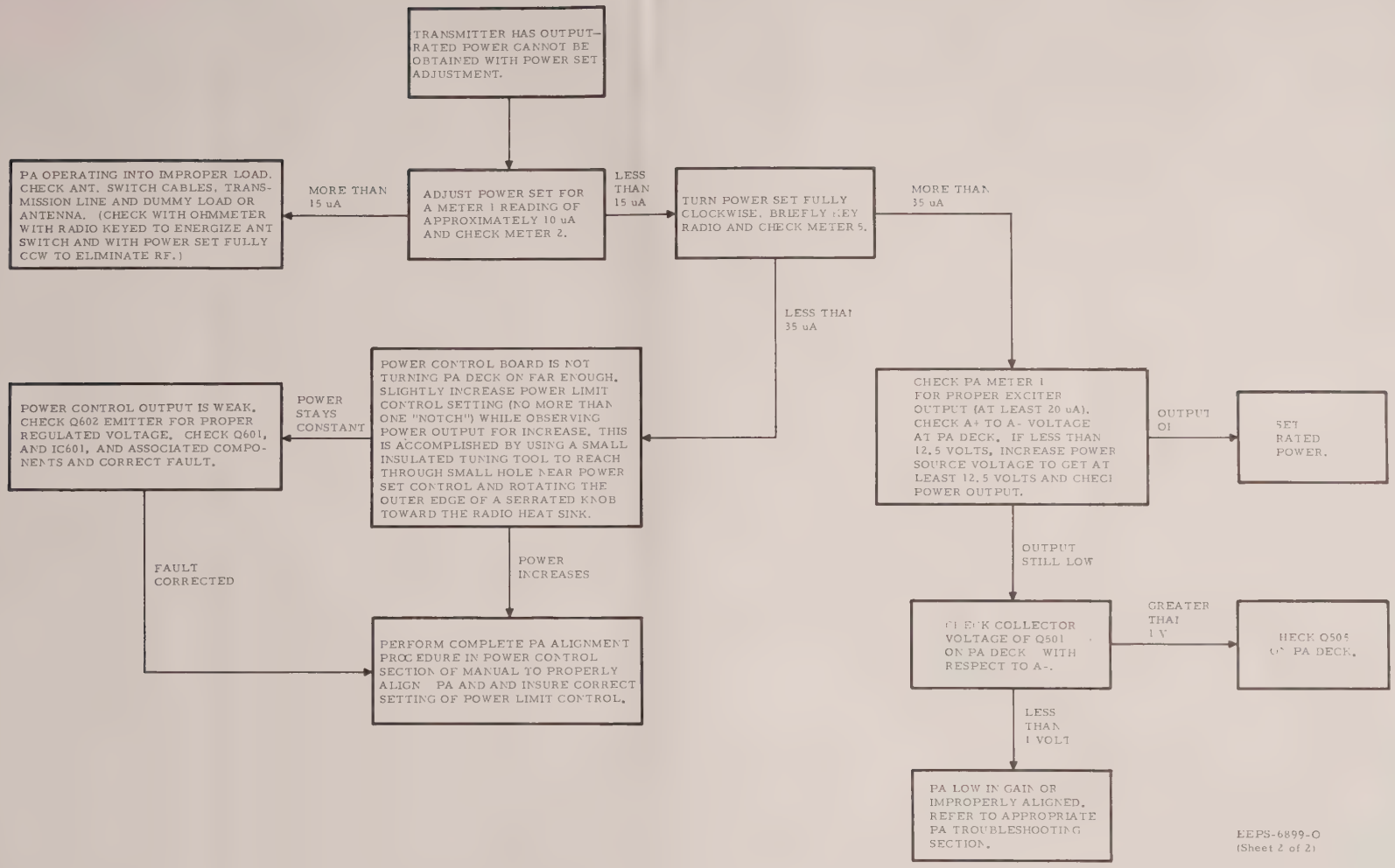


NOTES. UNLESS OTHERWISE SPECIFIED

1. ALL RESISTANCE VALUES ARE IN OHMS
2. ALL CAPACITANCE VALUES ARE IN MICROFARADS
3. IC POWER PIN OUT

REF DESIG	IC TYPE	GND	V_{CC}
U1	SN74L04N	7	14
U2,3	SN74L90N	10	5
U4	SN74L123	8	16
U5,6	SN74L10N	7	14
U7,11	SN74L00N	7	14
U8	SN74L93N	11	4
U9	SN74L73N	11	4
U10	SN74L74N	7	14

Figure 9-5
Schematic Diagram, A3 Receiver Logic and Loop Control



EEPS-6899-O
(Sheet 2 of 2)

POWER CONTROL BOARD

Power Control Board
Troubleshooting Chart
Motorola No. EEPS-6899-O
(Sheet 2 of 2)
7/29/74-NPC

COMPLETE POWER AMPLIFIER ALIGNMENT PROCEDURE

NOTE

If the transmitter frequency is to be changed, first realign the exciter board per the exciter alignment procedure.

STEP	ADJUST	METERING PLUG LOCATION	SELECTOR SWITCH POSITION	OSC & METER REV SWITCH POSITION	STAGE AND PROCEDURE
1					If the power amplifier is to be realigned greater than ±1 MHz from the original frequency, proceed with step 2. If the power amplifier is to be realigned less than ±1 MHz from the original frequency, remove the power control board shield, move the metering plug to the power control board and proceed to step 3.
2	C501 POWER LIMIT				PRE-ALIGNMENT - Set capacitor C501 fully clockwise. Remove the power control board shield and move the metering plug to the power control board. Use tuning tool #66A82846D01, or equivalent, to pre-align the POWER LIMIT control located on the component side of the board. Access to this control is provided by a small slot located approximately 3/4-inch from the POWER SET access hole, toward the rear of the radio. The tuning tool is used to rotate the outer edge of a serrated knob. Adjust the POWER LIMIT control to the end of its travel by rotating the edge of the knob away from the heat sink.
3	POWER SET	POWER CONTROL BOARD			TRANSMITTER OUTPUT - Adjust the POWER SET control to the maximum clockwise position.
4	C501	POWER CONTROL BOARD	5	METER REV REF B	PA DRIVER OUTPUT - Observe meter 5. If this indication is LESS than 50 uA (full scale), proceed with step 5. If this indication is GREATER than 50 uA, tune C501 for an on-scale reading.
5	POWER LIMIT	POWER CONTROL BOARD	Wattmeter or 1	METER REV REF A	TRANSMITTER OUTPUT - Adjust the POWER LIMIT control toward the heat sink until either rated output is attained or no further increase in power output is observed. In either case, adjust the POWER LIMIT control for an approximate 5- to 10-watt reduction.
6	C501	POWER CONTROL BOARD	5	METER REV REF B	PA DRIVER OUTPUT - Tune C501 for a minimum meter 5 reading.

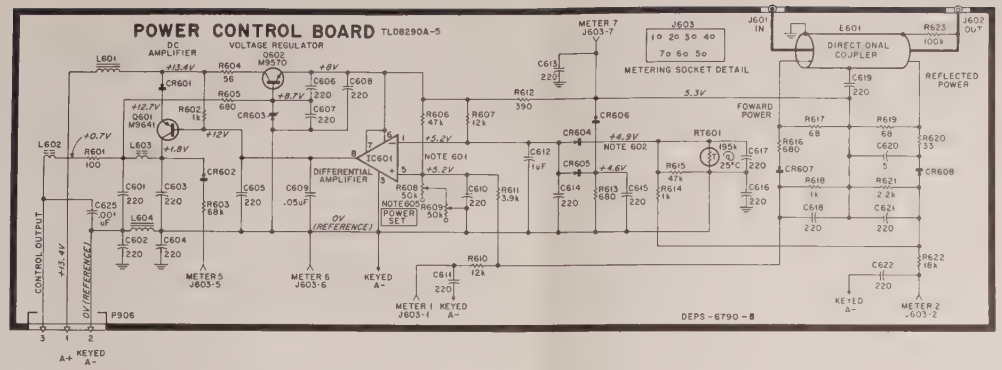
ALIGNMENT PROCEDURE (Cont'd)

STEP	ADJUST	METERING PLUG LOCATION	SELECTOR SWITCH POSITION	OSC & METER REV SWITCH POSITION	STAGE AND PROCEDURE
7	POWER LIMIT	POWER CONTROL BOARD	Wattmeter or 1	METER REV REF A	TRANSMITTER OUTPUT - Adjust the POWER LIMIT control for approximately 50 W. Repeat step 6. NOTE: If the required output cannot be obtained, repeat steps 5 and 6.
8	POWER LIMIT	POWER CONTROL BOARD	5	METER REV REF B	Replace the power control board shield. If meter 5 exceeds 50 uA when the shield is replaced, remove the shield and adjust the POWER LIMIT control slightly (turn knob AWAY from heat sink) until an on-scale reading -- 50 uA or less -- is obtained with the shield replaced. The power output should be at least that specified in step 7.
9	POWER SET	POWER CONTROL BOARD	Wattmeter or 1	METER REV REF A	TRANSMITTER OUTPUT - Adjust the POWER SET control for rated power out and repeat step 6.
10		PA	5	METER REV REF B	FINAL COLLECTOR CURRENT - Move the metering plug to the PA. Measure the final collector current (I_C). I_C, in amperes, is the meter 5 reading (0-50) x 2.
11		PA	6	METER REV REF B	FINAL COLLECTOR VOLTAGE - Measure the final collector voltage (V_C). V_C is the meter 6 reading (0-30 V scale).
12					Determine the final input power (P_{in}). P_{in} equals $V_C \times I_C$. P_{in} should be less than 90 W.

POWER CONTROL BOARD COMPONENT LOCATIONS

REF. SYM.	LOCATION	REF. SYM.	LOCATION
C601	B1	IC601	A4
C602	B2	L601	B2
C603	A2	L602	B1
C604	A4	L603	B1
C605	A2	L604	A1
C606	A2	Q601	A2
C607	A1	Q602	A2
C608	A3	R601	B1
C609	A2	R602	A1
C610	A4	R603	A2
C611	A2	R604	A2
C612	A3	R605	B1
C613	B2	R606	A4
C614	A4	R607	A3
C615	A3	R608	A4
C616	A2	R609	A4
C617	A4	R610	B3
C618	B3	R611	A3
C619	B3	R612	A3
C620	B3	R613	A3
C621	A3	R614	B4
C622	A2	R615	A4
C625	B1	R616	B2
CR601	A1	R617	B3
CR602	A2	R618	B3
CR603	A1	R619	B3
CR604	A3	R620	B3
CR605	A3	R621	B4
CR606	A3	R622	A3
CR607	B2	R623	B4
CR608	B4		
E601	B3	RT601	A4

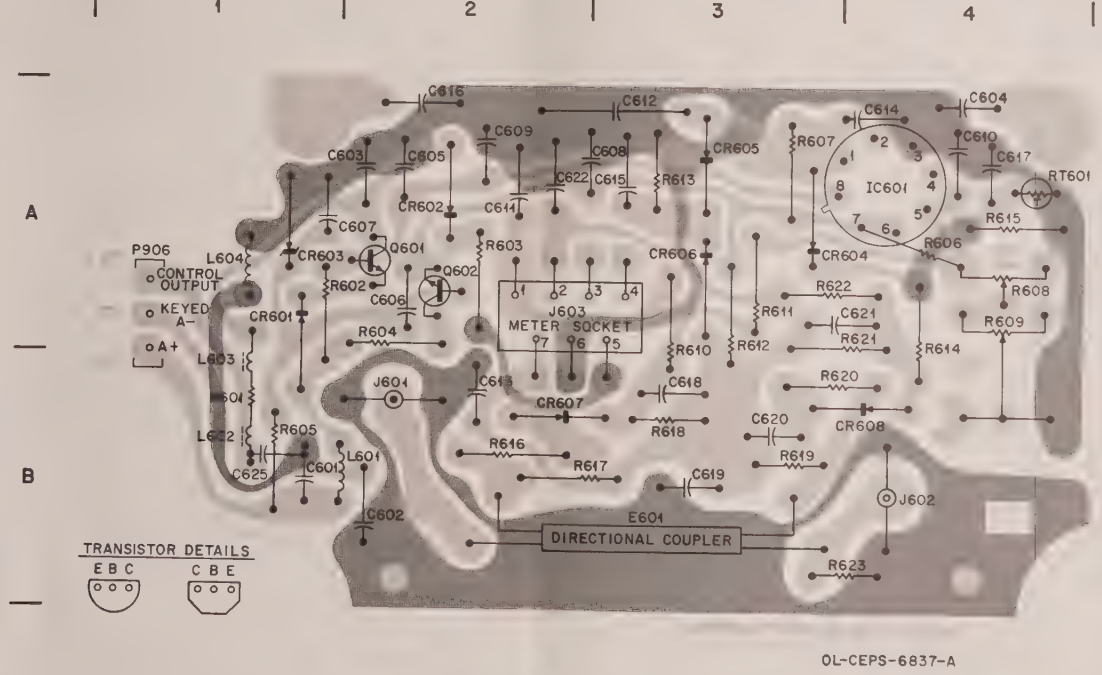
EPS-6927-A



POWER CONTROL BOARD

601. VOLTAGES AT PINS 1 AND 5 SHOULD DIFFER BY LESS THAN 50 mV.
602. VOLTAGE MEASURED AT 25 DEGREES C.
603. TYPICAL VOLTAGES UNDER NORMAL OPERATING CONDITIONS.
604. UNLESS OTHERWISE STATED: CAPACITOR VALUES ARE IN PICOFARADS.
605. FACTORY ADJUSTMENT, REFER TO TROUBLESHOOTING SECTION.

EPS-6777-O



OL-CEPS-6837-A

PREVIOUS REVISIONS AND PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

TLD8290A-5
150.8-174 MHz Power Control Board
Schematic Diagram and Circuit Board Detail
Motorola No. 63P81013E09-B
7/29/74-NPC

POWER CONTROL BOARD

REVISIONS

63P81013E09-B

CHASSIS AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
TLD8290A-5	C625	ADDED 21-82187E14, .001 uF ±10%; 100 V	P906-2, 3

ELECTRICAL PARTS LIST

IMPORTANT

USE ONLY THE FOLLOWING MOTOROLA PART NUMBERS WHEN ORDERING REPLACEMENT PARTS

TLD8290A Power Control Board PL-1297-A

REFERENCE SYMBOL	MOTOROLA PART NO	DESCRIPTION
		CAPACITOR, fixed:
C601 thru 608	21-83596E10	220 pF ±20%; 500 V
C609	21-82372C04	.05 uF +80-20%; 25 V
C610	21-83596E10	220 pF ±20%; 500 V
C611	21-83596E10	220 pF ±20%; 500 V
C612	23-83214C04	1 uF ±20%; 15 V
C613 thru 619	21-83596E10	220 pF ±20%, 500 V
C620	21-82133G53	5 pF ±0.5 pF; 500 V; NP0
C621	21-83596E10	220 pF ±20%; 500 V
C622	21-83596E10	220 pF ±20%; 500 V
C625	21-82187E14	.001 uF ±10%; 100 V
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR601	48-83654H01	silicon
CR602	48-82392B03	silicon
CR603	48-83696E04	silicon; Zener type; 9.1 V
CR604	48-82392B12	silicon
CR605	48-82392B12	silicon
CR606	48-82392B12	silicon
CR607	48-84616A01	silicon
CR608	48-84616A01	silicon
		RF POWER SENSING UNIT:
E601	58-84685B01	directional coupler
		INTEGRATED CIRCUIT:
IC601	51-84320A02	type M2002
		CONNECTOR, receptacle:
J601	28-84227B02	male; coaxial; miniature type
J602	9-84231B02	female; coaxial; miniature type
J603	9-84207B01	female; 7-contact
		COIL, RF:
L601	24-83961B01	choke; 3 turns on ferrite core; coded BRN
L602	76-83960B01	ferrite bead
L603	24-83961B01	choke; 3 turns on ferrite core; coded BRN
L604	76-83960B01	ferrite bead
		CONNECTOR, plug:
P906		consists of 3 male contact terminals (Part No. 29C84028H01) mounted on edge of circuit board
		TRANSISTOR: (SEE NOTE)
Q601	48-869641	P-N-P; type M9641
Q602	48-869570	N-P-N; type M9570
		RESISTOR, fixed: ±10%; 1/4 W; unl stated
R601	17-82291B21	100 ±5%; 3 W
R602	6-127802	1k
R603	6-129144	68k
R604	6-129860	56
R605	6-129984	680 ±5%
R606	6-128902	47k
R607	6-129230	12k
R608	18-83083G26	var: 50k ±30%
R609	18-83083G20	var: 50k ±30%; "off" (open circuit) at fully clockwise setting
R610	6-129887	12k ±5%
R611	6-129232	3.9k
R612	6-124A39	390 ±5%
R613	6-129984	680 ±5%
R614	6-127802	1k
R615	6-128902	47k
R616	6-129984	680 ±5%
R617	6-124A21	68 ±5%
R618	6-127802	1k
R619	6-124A21	68 ±5%
R620	6-124A13	33 ±5%
R621	6-128689	2.2k
R622	6-131526	18k ±5%
R623	6-129226	100k
		THERMISTOR:
RT601	6-867628	194k ±10%; @ [illegible]

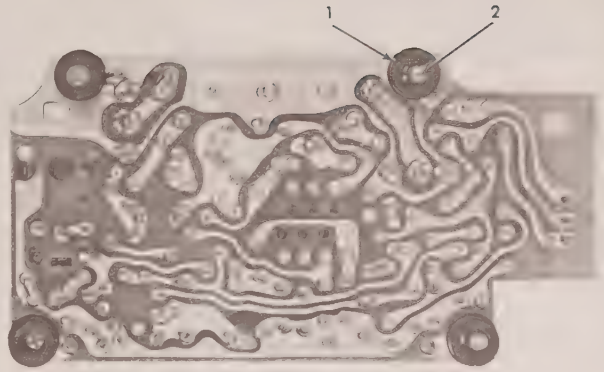
NOTE:

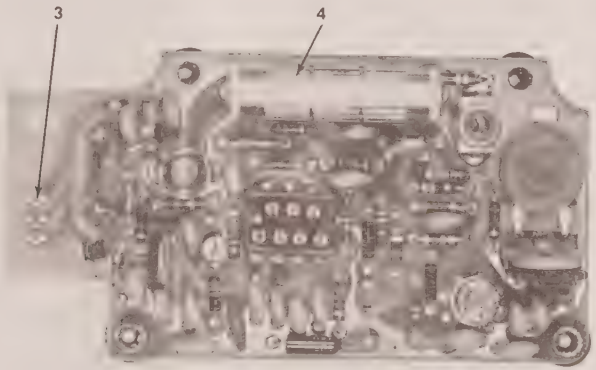
Replacement diodes and transistors must be ordered by Motorola part number only for optimum performance.

PARTS LIST

PL-854-A

CODE	MOTOROLA PART NO.	DESCRIPTION
1	42[illegible]	RETAINER
2	3[illegible]	SCREW
3	2[illegible]	TERMINAL
4	42[illegible]	CLIP
	NON-CODED ITEM	
	55B84300B04	HANDLE, plastic





BEPS-6542-O

POWER CONTROL BOARD

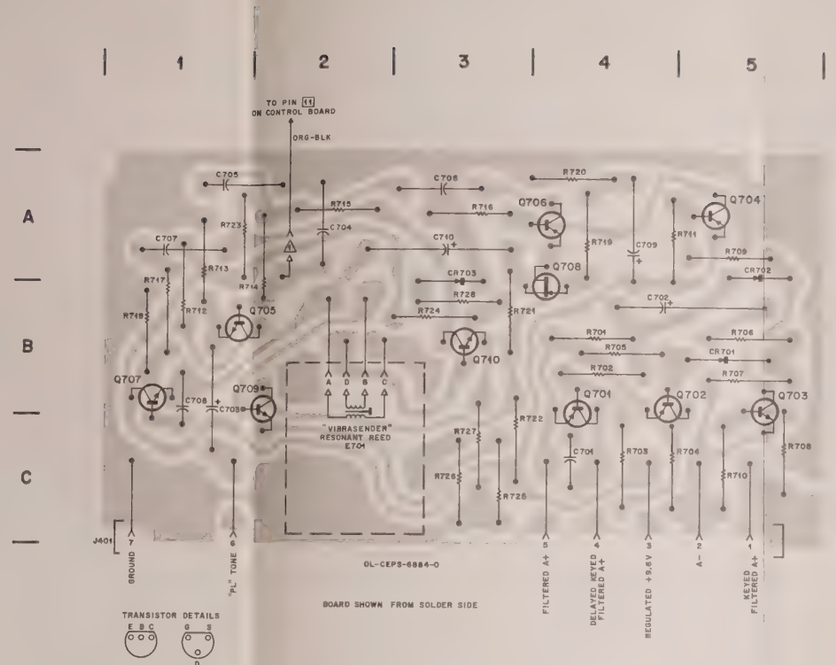
Mechanical and Electrical Parts List
Motorola No. PEPS-6922-B
7/29/74-NPC

"PL" ENCODER BOARD COMPONENT LOCATIONS

REF. SYM.	LOCATION
C701	C4
C702	B5
C703	B1
C704	A2
C705	A1
C706	A3
C707	A1
C708	B1
C709	A4
C710	A3
CR701	B5
CR702	A5
CR703	A3
E701	B2
Q701	B4
Q702	B4
Q703	B5
Q704	A5
Q705	B1
Q706	A4
Q707	B1
Q708	A4
Q709	B2
Q710	B3
R701	B4
R702	B4

REF. SYM.	LOCATION
R703	C4
R704	C4
R705	B4
R706	B5
R707	B5
R708	C5
R709	A5
R710	C5
R711	A4
R712	B1
R713	A1
R714	A2
R715	A2
R716	A3
R717	B1
R718	B1
R719	A4
R720	A4
R721	B3
R722	C3
R723	A1
R724	B3
R725	C3
R726	C3
R727	C3
R728	B3

EPS-6933-O



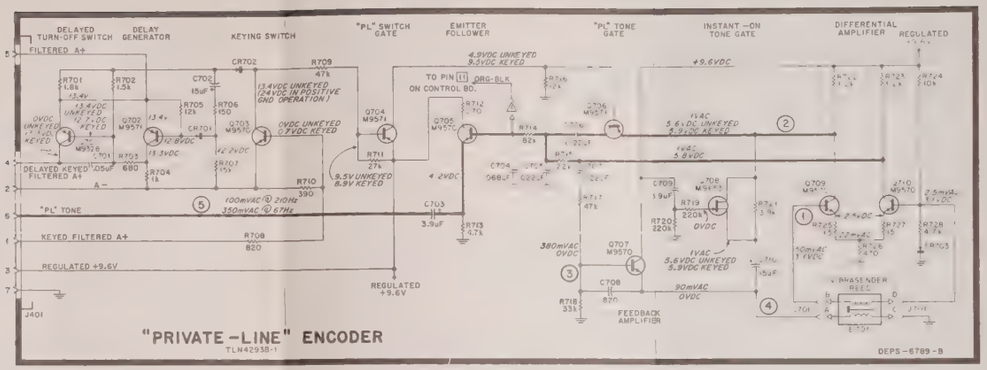
"PL" ENCODER

701. ALL AC VOLTAGE MEASUREMENTS ARE RMS VALUES. ALL AC VOLTAGES ARE SINUSOIDAL EXCEPT Q707 EMITTER, METER READING DEPENDENT UPON METER RESPONSE TO NON-SINUSOIDAL WAVE.

702. DC VOLTAGE MEASUREMENTS IN Q701, Q702 & Q703 STAGES TAKEN IN RESPECT TO A-. VOLTAGES FOR ALL OTHER STAGES TAKEN IN RESPECT TO CHASSIS GROUND. ALL DC VOLTAGES MAY BE MEASURED WITH 20,000 OHM-PER-VOLT METER OR HIGH IMPEDANCE DC VOLTMETER (11 MEGOHM) EXCEPT BASE OF Q705 WHICH CAN ONLY BE MEASURED WITH A HIGH IMPEDANCE METER.

703. UNLESS OTHERWISE STATED: CAPACITOR VALUES ARE IN PICOFARADS.

EPS-6782-O



OSCILLOSCOPE WAVEFORMS MEASURED UNDER FOLLOWING CONDITIONS

1. WAVEFORMS SHOWN USING 100 Hz "VIBRASENDER" RESONANT REED
2. VERTICAL SENSITIVITY SHOWN UNDER EACH WAVEFORM
3. HORIZONTAL DEFLECTION = 5 msec/DIV
4. ALL WAVEFORMS MEASURED IN RESPECT TO CHASSIS GROUND

EPS 6781-O

"PL" ENCODER WAVEFORMS

REVISIONS

63P81013E27-A

CHASSIS AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION

PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

"Private-Line" Encoder Schematic Diagram and Circuit Board Detail
Motorola No. 63P81013E27-A
7/29/74-NPC

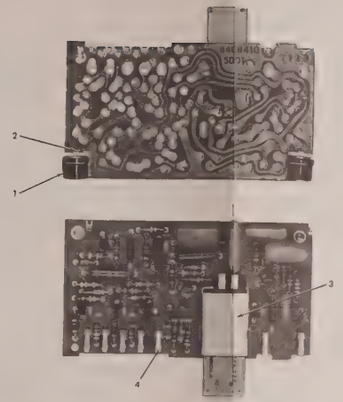
MECHANICAL PARTS LIST

IMPORTANT

USE ONLY THE FOLLOWING MOTOROLA PART NUMBERS WHEN ORDERING REPLACEMENT PARTS

TLN4293B "Private-Line" Encoder PL-1308-O

CODE	MOTOROLA PART NO.	DESCRIPTION
1	42-84284B01	RETAINER, screw: 2 req'd
2	3-138162	LOCKSCREW, tapping: No 4 x 3/8" Phillips hex head; 2 req'd
3	42-84116B02	SOCKET & BRACKET ASSEMBLY: for "Vibrasendor" Resonant Reed
4	9-83011H01	TERMINAL, pin: female 7 req'd



AEPS-6945-O

"PL" ENCODER

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

ELECTRICAL PARTS LIST

IMPORTANT

USE ONLY THE FOLLOWING MOTOROLA PART NUMBERS WHEN ORDERING REPLACEMENT PARTS

TLN4293B PL Encoder Board PL-1295-A

		CAPACITOR, fixed:
C701	21-82372C04	.05 uF +80-20%; 25 V
C702	23-83214C26	15 uF ±20%; 25 V
C703	23-84764H08	3.9 uF ±20%; 15 V
C704	8-83813H05	.068 uF ±10%; 50 V
C705	8-83813H08	.022 uF ±10%; 50 V
C706	8-83813H11	0.22 uF ±10%; 50 V
C707	8-83813H11	0.22 uF ±10%; 50 V
C708	21-82187B23	820 pF ±10%; 500 V
C709	23-84762H08	3.9 uF ±20%; 15 V
C710	23-84762H09	15 uF ±20%; 20 V
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE I)
CR701	48-83654H01	silicon
CR702	48-83654H01	silicon
CR703	48-83654H01	silicon
		"VIBRASENDER" RESONANT REED: (SEE NOTE II)
E701	TLN6824A	plastic unit
		CONNECTOR, receptacle:
J401		consists of 7 female contact terminals (Part No. 9B83011H01) mounted on edge of circuit board
		TRANSISTOR: (SEE NOTE I)
Q701	48-869328	P-N-P; type M9328
Q702	48-869571	P-N-P; type M9571
Q703	48-869570	N-P-N; type M9570
Q704	48-869571	P-N-P; type M9571
Q705	48-869570	N-P-N; type M9570
Q706	48-869571	P-N-P; type M9571
Q707	48-869570	N-P-N; type M9570
Q708	48-869653	field-effect; N-channel: M9653
Q709	48-869570	N-P-N; type M9570
Q710	48-869570	N-P-N; type M9570
		RESISTOR, fixed; ±5%; 1/4 W; unl stated
R701	6-129269	1.8k ±10%
R702	6-129681	1.5k
R703	6-129984	680
R704	6-129805	1k
R705	6-129887	12k
R706	6-129862	150 ±10%
R707	6-129236	15k
R708	6-129432	820 ±10%
R709	6-128902	47k ±10%
R710	6-129863	390 ±10%
R711	6-127806	27k ±10%
R712	6-129752	270 ±10%
R713	6-129669	4.7k
R714	6-124A95	82k
R715	6-129667	22k
R716	6-129230	12k ±10%
R717	6-124A89	47k
R718	6-129526	33k
R719	6-129147	220k
R720	6-129147	220k
R721	6-124A63	3.9k
R722	6-129708	1.2k
R723	6-129708	1.2k
R724	6-129668	10k
R725	6-124A05	15
R726	6-129709	470
R727	6-124A05	15
R728	6-129669	4.7k

NOTES:

I. Replacement diodes and transistors must be ordered by Motorola part number only for optimum performance.

II. The "Vibrasender" Resonant Reed is not a part of the encoder board. When ordering a complete board, the reed must be ordered separately.

CABLE CONNECTOR WIRING TABLE FOR
"A" AND "B" SUFFIX AND 8-FREQUENCY
MICOR RADIO SET MODELS

P1102 MULTI-FREQ. MODELS ONLY			P1101		
POS.	WIRE COLOR	TERMINATION	WIRE COLOR	TERMINATION	POS.
1	GRAY	F3 SELECT	YEL	SW BATT (HOT)	1
2	--	KEYING BLANK	EMPTY		2
3	BLK	F4 SELECT	ORG	SPKR AUDIO INPUT (+)	3
4	WHT-BLK	F5 SELECT	BLK-BLU	"PL" SELECT	4
5	WHT-GRAY	EXTRA WIRE (NOTE 3)	VIO	EXTRA WIRE (N.C. EITHER END)	5
6	WHT-VIO	NOTE 4	GRN	SPKR AUDIO OUTPUT (-)	6
7	WHT-ORG	F8 SELECT	BLK-GRAY	EXTENDER SELECT	7
8	WHT-YEL	NOTE 4	---	KEYING BLANK	8
9	WHT-RED	F7 SELECT	BLK-VIO	(GROUND)	9
10	WHT-BLU	NOTE 4	SHIELD	SHIELD (SPIRAL) (GROUND)	10
11	BLU	F1 SELECT	BLK-YEL	MIC AUDIO OUTPUT	11
12	RED	HANDSET SW BOX (NOTE 2)	GRN	BATT HOT (SEE TABLE A)	12
13	---	KEYING BLANK	ORG	BATT HOT IGN SW (SEE TABLE A)	13
14	WHT-BRN	F6 SELECT	BLK-RED	SW BATT (HOT)	14
15	EMPTY		GRN & [illegible]	"PL" HANG-UP SWITCH BOX	15
16	EMPTY		BLK-BRN	DISCR. EMIT. FOLLOWER OUTPUT	16
17	RED-BLU	EXTRA WIRE (NOTE 3)	BRN	SQUELCH	17
18	EMPTY		---	KEYING BLANK	18
19	WHT-GRN	NOTE 4	BLK & [illegible]	"PL" HANG-UP SWITCH BOX	19
20	YEL	HANDSET SW BOX (NOTE 2)	BLK-GRN	VOLUME	20
21	BRN	HANDSET SW BOX	SHIELD	SHIELD (3 CONDUCTOR) GROUND	21
22	WHT	F2 SELECT	BLK-ORG	PUSH-TO-TALK	22

NOTES:
1. 'PL' MODELS ONLY.
2. SEPARATE WIRE - NOT PART OF THE MULTI-CONDUCTOR TABLE.
3. NO CONNECTION ON RADIO END.
4. NOT USED.

EPS-14207-O

NOTE
CONNECTOR POSITIONS DO NOT CORRESPOND TO WIRE COLOR CODE NUMBERS

CABLE

1101. CABLE SHOWN CONNECTED FOR NEGATIVE GROUND OPERATION. REFER TO INSTALLATION DETAIL FOR CONVERSION TO POSITIVE GROUND OPERATION OR CONNECTION ARRANGEMENT ON POSITIVE GROUND CABLES.

1102. BLK-VIO JUMPERS JOINED WITH BLU JUNCTION-LUG.

1103. YEL JUMPERS JOINED WITH YEL JUNCTION-LUG.

EPS-6193-B

PARTS LIST

IMPORTANT

USE ONLY THE FOLLOWING MOTOROLA PART NUMBERS WHEN ORDERING REPLACEMENT PARTS

CABLE KITS

TKN6452A, B (18 ft.) 1-Frequency
TKN6453A, B (22 ft.) 1-Frequency
TKN6454A, B (18 ft.) 4-Frequency
TKN6455A, B (22 ft.) 4-Frequency
TKN6470A, B (22 ft.) 4-Frequency, Positive Ground
TKN6606A (18 ft.) 12-Frequency
TKN6607A (22 ft.) 12-Frequency
TKN6608A (22 ft.) 12-Frequency, Positive Ground
TKN6456A Control Head Power Cable
TKN6457A Power Cable & Fuse (45-Watt High Band Only)
TKN6458A Power Cable & Fuse (All Other Radios)

PL-1047-C

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		FUSE, cartridge:
F1101	65K86099	7.5 Amp
F1102	65K86099	7.5 Amp
F1103	65S136969	15 Amp; 32 V (TKN6457A only)
	or65C84161B01	special: 40 Amp; 32 V (TKN6458A only)
		CONNECTOR, plug:
P1101	14C84556B01	BLACK: does not incl. 9C84151B01 CONTACT, female (TKN6452B, TKN6453B, TKN6454B and TKN6455B only)
P1102	14C84556B02	BLUE: does not incl. 9C84151B01 CONTACT, female (TKN6454B and TKN6455B only)
P1105	1V84307A89	incl. 9C84086B01 CONNECTOR, plug: female; 37 cont; 15D84044C01 HOUSING (front); 15D84045C01 HOUSING (rear); 3S7178 SCREW, machine: No. 6-32 x 5/16"; 2 req'd; 3S7346 SCREW, machine: No. 6-32 x 3/4"; 42C84046C01 CLAMP, strain relief (TKN6452B, TKN6453B, and TKN6470B only) or 42C84933E01 CLAMP, strain relief (TKN6606A, TKN6607A, and TKN6608A only) 3S132127 SCREW, tapping: No. 6-20 x 3/4" plain hex head (TKN6452B, TKN6453B, TKN6454B, TKN6455B, and TKN6470B only) OR incl. 9C84086B01 CONNECTOR plug: female; 37 cont; 15D84278A01 HOUSING (front); 15D84279B01 HOUSING (rear); 3S7178 SCREW, machine: No. 6-32 x 5/16"; 2 req'd. 3S7346 SCREW, machine: No. 6-32 x 3/4"; 42C84280B02 CLAMP, strain relief: 3S3350 SCREW, tapping: No. 4 x 1/2"; 3S136970 SCREW, tapping: No. 4 x 3/4" (TKN6452A, TKN6453A, TKN6454A and TKN6455A only)
		CABLE ASSEMBLY:
W1101	1V80711B09	incl. 30S10286C70 WIRE, #16 ga. str. (GRN) 88" long; 14A82882A01 BODY, fuseholder, 41A82885A01 SPRING, fuseholder, 42A82884A01 CLIP, fuseholder (TKN6456A only)
W1102	1V80711B08	incl. 30S10310A63 WIRE, #18 ga. str. (GRN) 12" long, 14A82883A01 CAP, fuseholder, 42A82884A01 CLIP, fuseholder, 9C84151B01 CONTACT, female (TKN6456A only)
W1103	1V80703A58	incl. 30K851875 CABLE, battery: #8 BLK, 5-1/2 ft. long and 29C84528B03 LUG, ring tongue (TKN6452B, TKN6453B, TKN6454B and TKN6455B)
W1104	1V80711B11	incl. 30S10310A62 WIRE, #18 ga. str. (ORG) 60" long; 14A82882A01 BODY, fuseholder, 41A82885A01 SPRING, fuseholder, 42A82884A01 CLIP, fuseholder(TKN6456A only)
W1105	1V80711B10	incl. 30S10310A62 WIRE, #18 ga. str. (ORG) 9" long; 14A82883A01 CAP, fuseholder, 42A82884A01 CLIP, fuseholder and 9C84181B01 CONTACT, female (TKN6456A only)
W1106	1V80711B12	incl. 30K812505 CABLE, battery: #8 (RED) 2 ft. long and 29K824434 LUG, ring tongue (TKN6457A only)
W1107	30K812505	battery: #8 (RED) 25-1/2 ft. long (TKN6452B, TKN6453B, TKN6454A and TKN6455A only)
W1108	1V80711B04	incl. 30C858513 CABLE, 13-conductor; 18 ft. long, 9C84151B01 CONTACT, female; 31 req'd; 29K840421 LUG (YEL), 29A812980 LUG (BLUE); TKN6452B only
	or1V80711B05	incl. 30C858513 CABLE, 13-conductor; 22 ft. long, 9C84151B01 CONTACT, female; 31 req'd, 29K840421 LUG (YEL), 29A812980 LUG (BLUE); TKN6453B only
	or1V80711B06	incl. 30C864650 CABLE, 17-conductor; 18 ft. long, 9C84151B01 CONTACT, female; 39 req'd. 29K840421 LUG (YEL), 29A812980 LUG (BLUE) TKN6454B only
	or1V80711B07	incl. 30C864650 CABLE, 13-conductor; 22 ft. long, 9C84151B01 CONTACT, female; 39 req'd. 29K840421 LUG (YEL), 29A812980 LUG (BLUE); TKN6455B and TKN6470B only
	or IV80735B02	incl. 30D84875E01 CABLE, 27-conductor; 18 ft. long, 9C84151B03 CONTACT, female; 59 req'd. 29K840421 LUG (YEL); 29A812980 LUG (BLU); TKN6606A only
	or IV80735B03	incl. 30D84875E01 CABLE, 27 conductor; 22 ft. long, 9C84151B03 CONTACT, female; 59 req'd. 29K840421 LUG (YEL) 29A812980 LUG (BLU) TKN6607A and TKN6608A only
		FUSEHOLDER:
XF1101		p/o W1101 and W1102
XF1102		p/o W1104 and W1105
XF1103	9C84277B01	special (TKN6457A only)
	or9C84277B02	special (TKN6458A only)

NON-REFERENCED ITEMS		
	42K867839	CLAMP, cable: (TKN6452B, TKN6453B, TKN6454B and TKN6455B only)
	42A89346	CLAMP, cable: (TKN6606A, TKN6607A, and TKN6608A only)
	42A893464	HOOK, cable clamp: ("S" hook) TKN6452B, TKN6453B, TKN6454B and TKN6455B only)
	42-84275B01	BRACKET, fuseholder

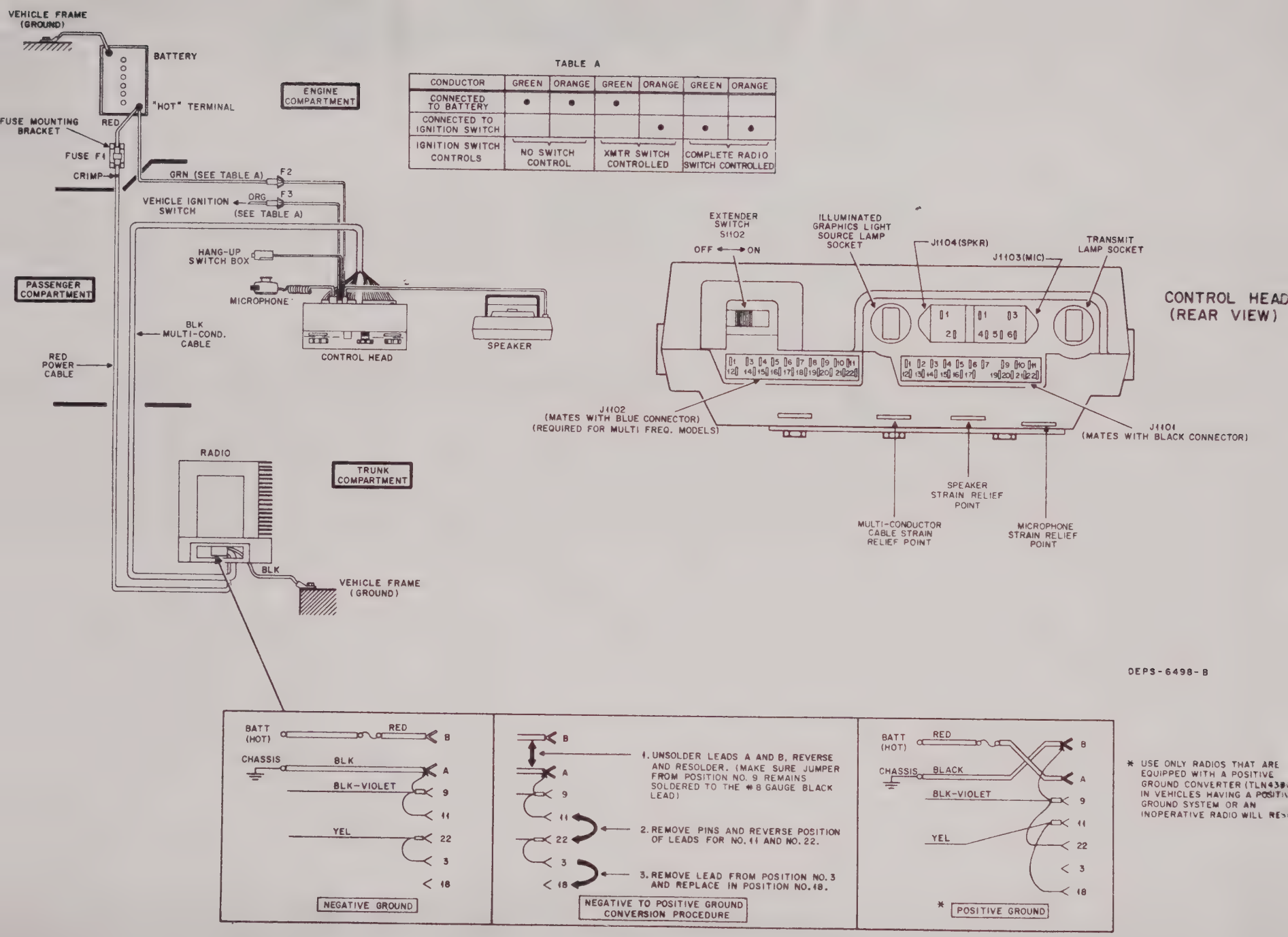


TABLE A

CONDUCTOR	GREEN	ORANGE	GREEN	ORANGE	GREEN	ORANGE
CONNECTED TO BATTERY	•	•	•			
CONNECTED TO IGNITION SWITCH				•	•	•
IGNITION SWITCH CONTROLS	NO SWITCH CONTROL		XMTR SWITCH CONTROLLED		COMPLETE RADIO SWITCH CONTROLLED	

* USE ONLY RADIOS THAT ARE EQUIPPED WITH A POSITIVE GROUND CONVERTER (TLN438
IN VEHICLES HAVING A POSITI
GROUND SYSTEM OR AN
INOPERATIVE RADIO WILL RES

SUPPLEMENT TO INSTRUCTION MANUAL 68P81012E10

FOR MODEL XM/R43RTH-1190AA MICOR RAILROAD RADIO

30 WATTS RF, 150-174 MHz

DESCRIPTION

Motorola XM/R43RTH-1190AA MICOR Railroad radios are 30 watt RF power output versions of the R 43RTH-1190AA model described in the accompanying instruction manual 68P81012E10.

For 30 watts RF output operation of MICOR Railroad radios, the POWER SET control is factory adjusted and permanently sealed for a maximum RF power output of 30 watts.

Any correspondence or communication in relation to this equipment must include complete model and serial numbers.

CANADIAN MOTOROLA ELECTRONICS COMPANY

3125 STEELES AVENUE EAST, WILLOWDALE, ONTARIO

68P09347M

MANUFACTURED IN CANADA UNDER PATENT AND TRADE MARK LICENCES FROM MOTOROLA INC., CHICAGO, ILLINOIS

RECEIVED 18 MAR 1981

"PRIVATE LINE" DISABLE OPTION MW1029 FOR MICOR FM TWO-WAY RADIOS WITH SYSTEMS 90 CONTROL HEAD

A) Model Breakdown Table for Micor "PL" Disable Option:

OPTION	DESCRIPTION			
MW1029	Automatic "PL" Disable: Micor with Systems 90 Control Head			
No. of Freq.	Omit	Description	Add	Description
4	CTCN1098A CTLN5181A	Control Head Mic Hang-Up Box	MTCN5536A	Control Head

B) Description:

Motorola Model MTLN9898A "PL" Disable Modification Kit is an add-to option for Micor radio sets, and provides a means by which the "PL" decoder in the receiver can be automatically disabled on one or more specific channels via the frequency selector switch. "PL" operation is permanently enabled on all other channels. The "PL" Disable Option deletes the CTLN5181A micro-phone hang-up box and replaces the standard control head with a modified version model MTCN5536A.

Model MTCN5536A Control Head is the same as the Systems 90 Control Head with alternate control module, model TCN1098A except for the addition of modification kit model MTLN9898A. Refer to Micor Systems 90 alternate Control Module manual 68P81102E37.

C) Theory of Operation:

(Refer to schematic diagram of alternate control module in instruction manual 68P81102E37).

MOTOROLA CANADA LIMITED
COMMUNICATIONS DIVISION
3125 Steeles Avenue East, Willowdale, Ontario M2H 2H6

CONTROL HEAD FOR "MICOR" RADIO

TCN1092B Control Head

MODEL TABLE

MODEL NUMBER	NO. OF FREQUENCIES
TCN1091B	1
TCN1092B	4
TCN1095A	1
TCN1096A	4
TCN1106A	8
TCN1112A	8
TCN1119A	12
TCN1124A	12
TCN1184A	5

TECHNICAL CHARACTERISTICS

Dimensions (excluding mounting bracket)	6-7/8" wide x 2" high x 3-3/4" deep
Weight	1 pound
Temperature Range	-30°C to +60°C
Current Drain	145 mA @ 13.8 V
Safety	Meets or exceeds Federal Safety Standards FS-201 & SAEJ921

1. DESCRIPTION

These Motorola mobile radio control heads are durable units providing ease of operation, illuminated labelling of controls (graphics), maintenance-free circuitry, and impact safety. A rugged circuit board eliminates virtually all wires, while a slide-switch, two potentiometers, and a rotary switch provide almost complete operator control of the radio set. A durable two-piece plastic housing encloses the circuit board and control head components while a resilient front bumper provides protection during accidental contact. For test purposes, an "Extender" switch is provided on the rear of the control head. This switch should be left in the ON position (inboard) during normal operation.

The recessed knurled VOLUME, frequency selector, and SQUELCH knobs project both above and below to permit adjustment by the operator. The power switch on-off actuator projects from the top when in the on position, below when off. Rotation of the frequency selector knob (multi-frequency models only) selects the desired receive and transmit frequency. The channel selected is numerically indicated on the frequency indicator dial directly above the selector knob. Rotation of the VOLUME control clockwise increases the volume. Clockwise rotation of the SQUELCH control increases the squelch threshold (requires a stronger signal before audio is heard). Labelling of controls is provided by visual graphics which are visible in the daylight and illuminated at night, while the red transmit indicator will be seen whenever the push-to-talk function is activated.

MOTOROLA INC.
Communications Division

SERVICE PUBLICATIONS
1301 E. Algonquin Road, Schaumburg, IL 60172

MOTOROLA PART NO.	DESCRIPTION
NON-CODED ITEM	
54B84111D01	MOUNTING TEMPLATE (TCN1091B, TCN1092B)

oded 9, 27, 28 and 29 are not individually replaceable.
d-replacement, order item No. 8 (TOP COVER
BLY).

AL PARTS LIST

PL-1049-G

	DIODE: SEE NOTE
48D83461E45	diode; Zener type; nom. 25 V
	LAMP, incandescent: miniature wedge base:
65B83554G01	12 V; 0.19 A; type No. 161
65B83554G01	12 V; 0.19 A; type No. 161
	CONNECTOR, receptacle:
	c/o (20) 29B84547B01 TERMINALS, pin: male
	c/o (20) 29B84547B01 TERMINALS, pin: male
	c/o (5) 29B84547B01 TERMINALS, pin: male
	c/o (2) 29B84547B01 TERMINALS, pin: male
	RESISTOR:
6S488090	fixed: 56 ±10%; 2 W
6S6291	fixed: 560 ±10%; 1/2 W
6S5581	fixed: 3.3k ±10%; 1/2 W
6S5581	fixed: 3.3k ±10%; 1/2 W
18C84584A02	variable: 25k ±30%; 1/4 W
18C84584A02	variable: 25k ±30%; 1/4 W
6S6373	fixed: 150 ±10%; 1/2 W
	SWITCH:
40C84622B02	slide: dpst; does not include 29S10134A86 LUG, connector: female; 4 required
40C84301C02	momentary slide; spst
40C84149C01	rotary; 4-position; non-shorting includes mounting hardware & adjustable stopwasher (not available separately)
40C84149C02	rotary; 8-position; non-shorting includes mounting hardware and (2) adjustable stopwashers (not available separately)
40C84149C03	rotary; 12 position; non-shorting includes a fixed non-adjustable stop; does not include mounting hardware
NON-REFERENCED ITEMS	
TLN4369B	PRINTED CIRCUIT BOARD ASSEMBLY; includes 29B84547B01 TERMINAL, contact; male; 47 required 42C84962C01 RETAINER, connector; 2 required
4-2636	LOCKWASHER: 3/8" internal tooth (for 12-freq. switch)
2-136272	NUT, hex: 3/8"-32 x 1/2" (for 12-freq. switch)

des must be ordered by Motorola part number only
formance.

					in power output is observed.
3	POWER SET C501 C502*	POWER CONTROL BOARD	5	METER REV. REF. B	Adjust C501, then C502, for a dip on meter 5. If a dip cannot be found, reduce POWER SET until meter 5 is less than 20 uA.
4		POWER CONTROL BOARD	Wattmeter or 1	METER REV. REF. A	Repeat steps 2 and 3 until rated power is reached. Proceed to step 7 when rated power is attained and meter 5 is less than 30 uA. If rated power cannot be reached and meter 5 is less than 30 uA proceed with step 5. If at this point meter 5 is greater than 30 uA and rated power has not been attained, refer to the power control troubleshooting chart.
5	R610	POWER CONTROL BOARD	Wattmeter or 1	METER REV. REF. A	Remove the power control board shield. Use tuning tool #66A82846D01, or equivalent, to adjust R610. Access to this control is provided by a small slot located approximately 3/4-inch from the POWER SET hole, toward the rear of the radio. Use the tuning tool to rotate the outer edge of the serrated knob toward the heat sink until either rated power is attained or no further increase in power output is observed. Replace power control shield.
6					Repeat steps 3 and 4.
7		PA	5	METER REV. REF. B	FINAL COLLECTOR CURRENT - Move the metering plug to the PA. Measure the final collector current (Ic). Ic, in amperes, is the meter 5 reading (10 A full scale) for 45- and 60-watt models; meter 5 reading (25 A full scale) for 90/110-watt models.
8		PA	6	METER REV. REF. B	FINAL COLLECTOR VOLTAGE - Measure the final collector voltage (Vc). Vc is the meter 6 reading (0-30 V scale).
9					Determine the final input power (Pin). Pin equals Vc x Ic. Pin should be less than: 90 W for 45 W models 120 W for 60 W models 180 W for 90 W models 200 W for 110 W models If Pin exceeds these levels, refer to Power Amplifier Troubleshooting Chart.

*C502 is used only on 90/110 watt models.

EPS-6543-B

SERVICE SHEET

MOTOROLA

132-174 MHZ "MICOR"®

FM Two-Way RADIO SETS

T43RTN-1100A	T53RTN-1100A	T63RTN-1100A	T73RTN-1100A
T43RTN-1190A	T53RTN-1190A	T63RTN-1190A	T73RTN-1190A
T43RTN-3100A	T53RTN-3100A	T63RTN-3100A	T73RTN-3100A
T43RTN-3190A	T53RTN-3190A	T63RTN-3190A	T73RTN-3190A

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5/10/74

ENGINEERING PUBLICATIONS
1301 E. ALGONQUIN ROAD
SCHAUMBURG, ILLINOIS 60172

ADJUSTMENTS

EXCITER ALIGNMENT PROCEDURE

(SEE "EXCERPTS FROM FCC REGULATIONS" ON THIS SHEET)

STEP	ADJUST	METERING PLUG LOCATION	TEST SET SELECTOR SWITCH POSITION	OSC. & METER REV. AND ADAPTER CABLE REF. SWITCHES	STAGE AND PROCEDURE
1					SET UP - Connect the test equipment and set switches as shown. Key the transmitter with the XMTR ON push-button on the portable test set.
2	POWER SET				OUTPUT - Turn the POWER SET control fully counterclockwise.
3	FREQUENCY SWITCH	EXCITER	2	OFF REF A	CHANNEL ELEMENT - Select the desired frequency on multi-frequency radio sets. Key the transmitter. The test set meter 2 should indicate at least 10 uA.
4	ALL EXCITER COILS	EXCITER	3	OFF REF A	PRE-ALIGNMENT - If the exciter is completely untuned and shows no meter 3 reading, set cores of all tuning coils to the top of their coil forms (away from circuit board) and proceed with step 5. If the exciter shows meter 3 readings, set cores of all tuning coils except L401 and L402 to the top of their coil forms (away from the circuit board). Tune L401 and L402 in that order for maximum meter indication. Go to step 7 of the procedure.
5	L401	EXCITER	2	OFF REF A	MODULATOR OUTPUT - Tune L401 for minimum meter reading.
6	L401, L402	EXCITER	3	OFF REF A	MODULATOR OUTPUT - Tune L402 then L401 for peak meter reading.
7	L403	EXCITER	3	OFF REF A	TRIPLER OUTPUT - Tune L403 for minimum meter reading.
8	L403, L404	EXCITER	4	OFF REF A	TRIPLER OUTPUT - Tune L404 and then L403 for peak meter reading.
9	L405	EXCITER	4	OFF REF A	FIRST DOUBLER OUTPUT - Tune L405 for minimum meter reading.
10	L405, L406	EXCITER	5	OFF REF A	FIRST DOUBLER OUTPUT - Tune L406 and then L405 for peak meter reading.
11	L407	EXCITER	5	OFF REF A	EXCITER OUTPUT - Tune L407 for minimum meter reading.
12	L407, L408	PA	1	METER REV. REF A	EXCITER OUTPUT - Move the metering plug to the PA. Tune L408 and then L407 for peak meter reading.
13					Repeat steps 6, 8, and 10.
14					Align the power amplifier.

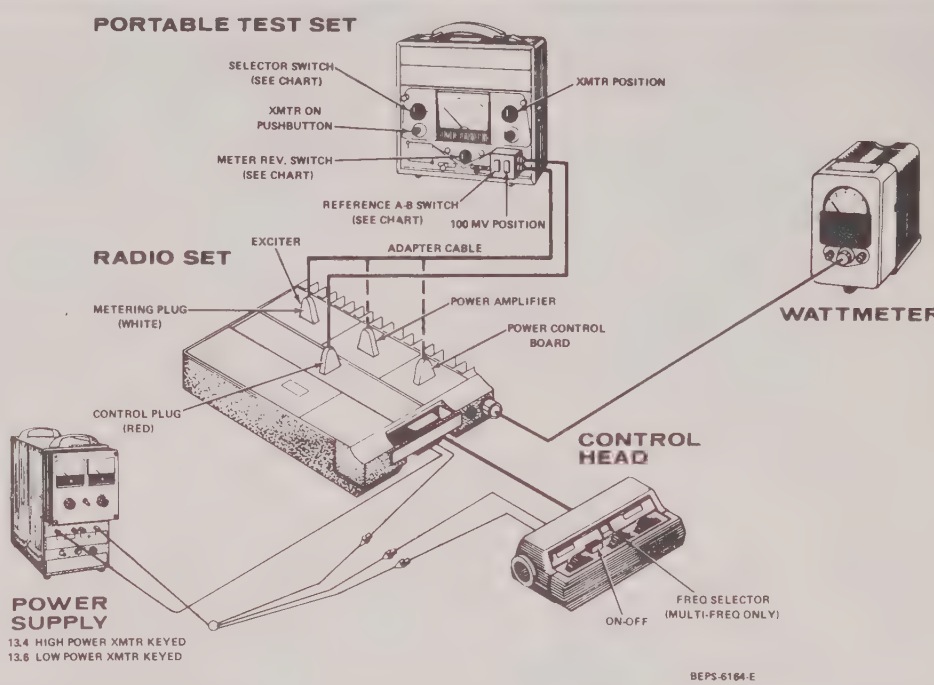
EPS-7258-A

POWER AMPLIFIER ALIGNMENT PROCEDURE

(45/60/90/110 WATTS)

NOTE: Portable Test Set Meter sensitivity switch should be on 100 mV for all readings.

STEP	ADJUST	METERING PLUG LOCATION	TEST SET SWITCH POSITION	REF & METER REV. SWITCH POSITION	PROCEDURE
1					Turn the POWER SET control fully counterclockwise (minimum power output). If the power amplifier is to be realigned less than ±1 MHz, proceed with step 2. Otherwise, prealign the board by setting C501 fully clockwise and C502 fully meshed.
2	POWER SET	POWER CONTROL BOARD	Wattmeter or 1	METER REV. REF. A	Key transmitter and slowly turn POWER SET control clockwise until rated power is attained, or until no further increase

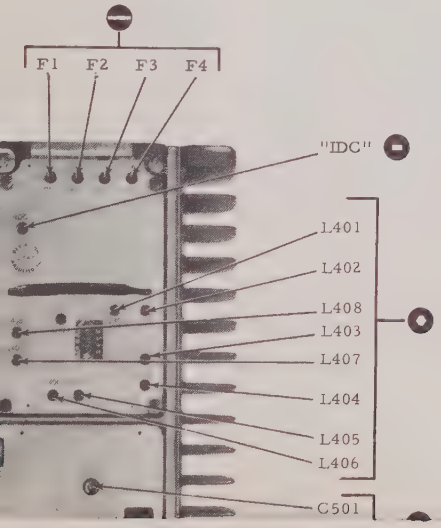


NOTE

USE ONLY RECOMMENDED TYPE BENCH POWER SUPPLY. SEE TABLE OF RECOMMENDED TEST EQUIPMENT IN MAINTENANCE SECTION.

ALIGNMENT SET-UP

LOCATIONS



OSCILLATOR FREQUENCY ADJUSTMENT

1. Set up the test equipment as shown for frequency measurement. Disconnect the audio oscillator from the portable test set.
2. Key the transmitter with no modulation, Key the transmitter with the XMTR ON pushbutton on the portable test set rather than with the microphone. On "Private-Line" radios, unplug the "Vibrasender" resonant reed from the PL tone generator.
3. Adjust the channel element warp capacitor for the selected channel to the exact desired frequency. On single-frequency models, adjust the F1 channel element warp capacitor. On multi-frequency models, adjust the warp capacitor which corresponds to the frequency selector switch setting on the control head; repeat for each frequency.

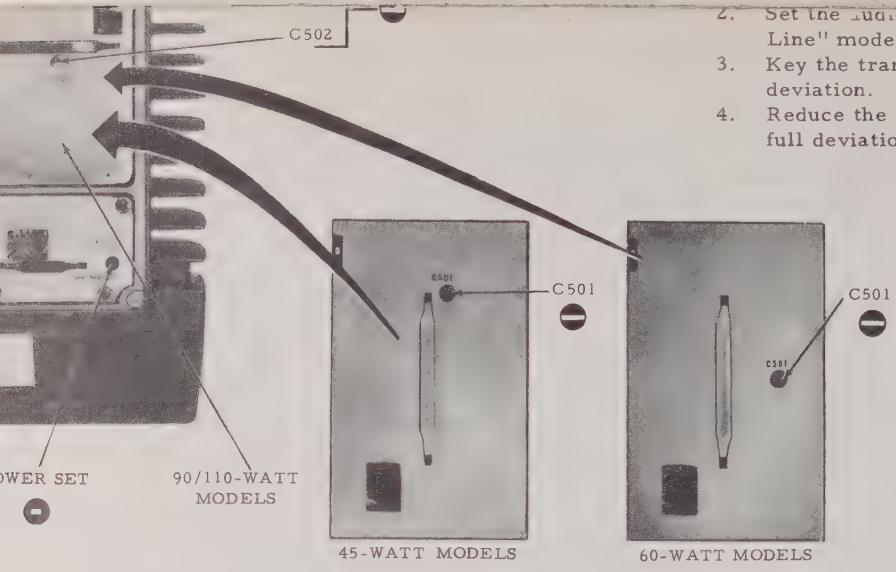
EPS-7255-C

"IDC" ADJUSTMENT PROCEDURE

1. Set up the test equipment as shown for deviation measurement. Connect the audio oscillator to the portable test set.

2. Set the audio oscillator to 1000 Hz and 1 volt. On "Private Line" models, replace the "Vibrasender" resonant reed.
3. Key the transmitter and adjust the IDC control for ±5 kHz deviation.
4. Reduce the tone oscillator output to .25 volt. Essentially full deviation should still be indicated.

EPS-7256-O



FREQUENCY CALCULATIONS

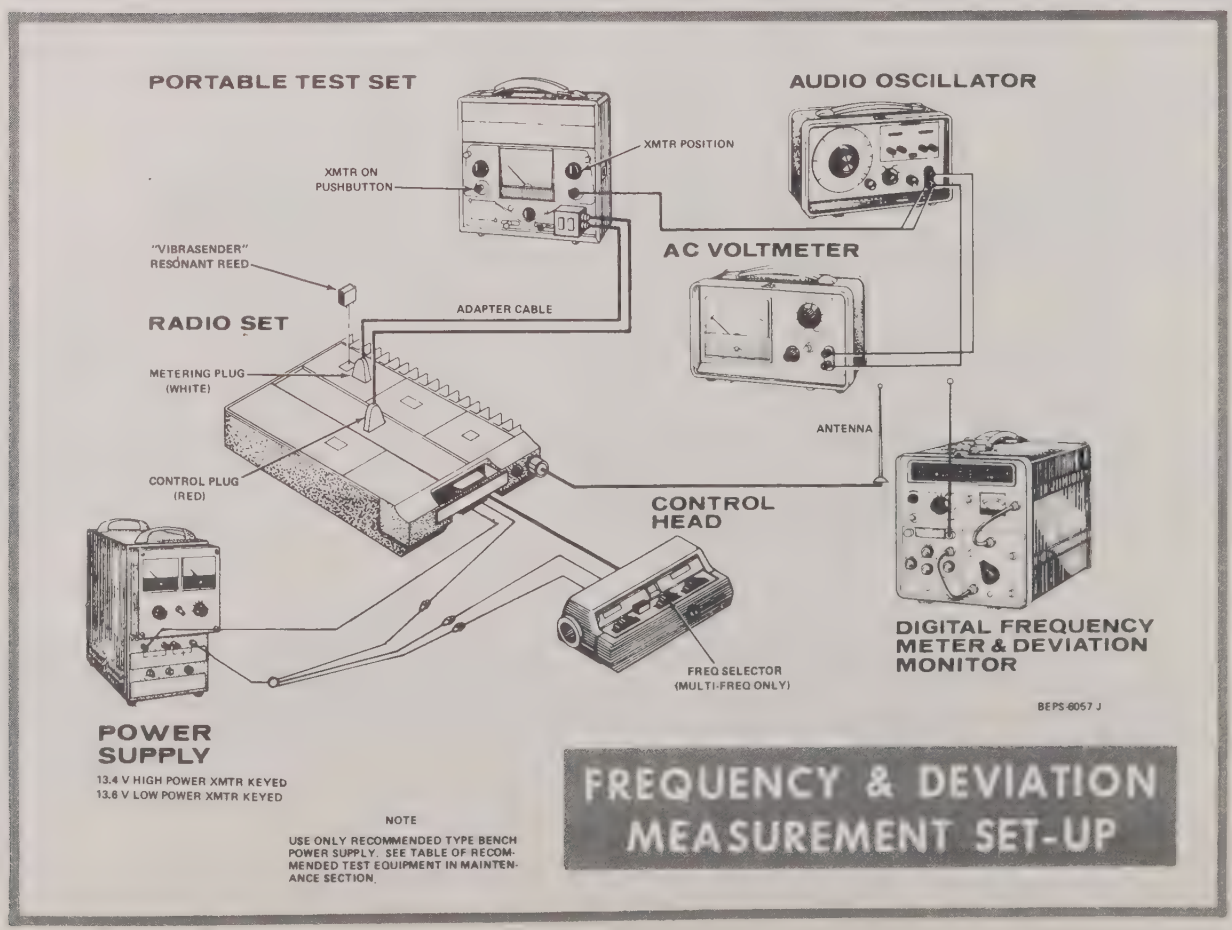
Where:

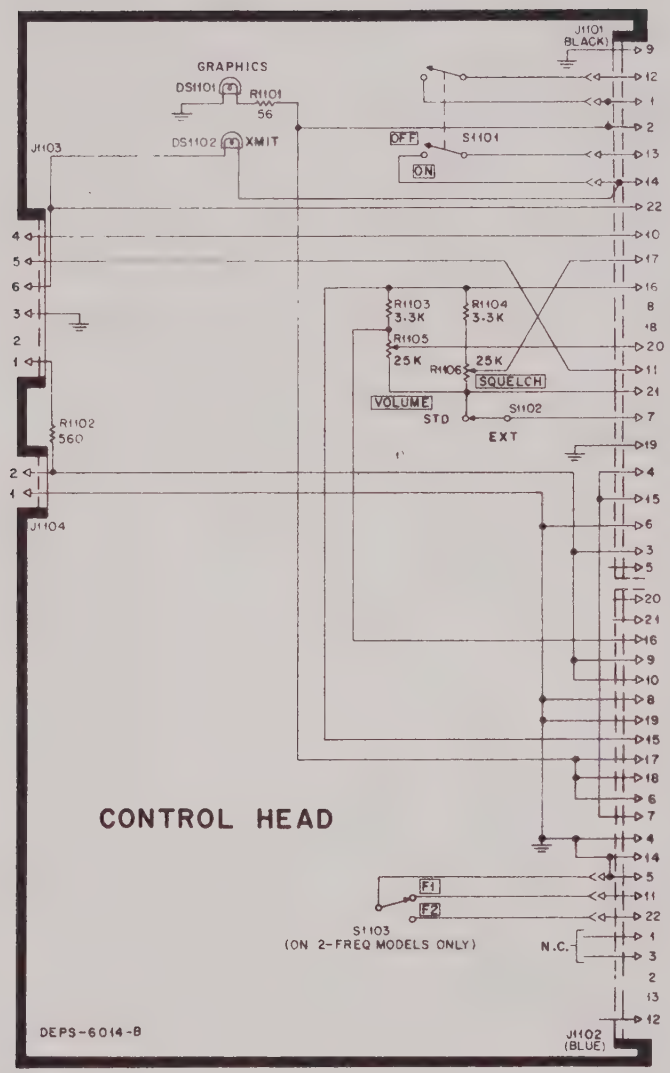
f_o = channel element frequency

f_c = carrier frequency

$$f_o = \frac{f_c}{12} \qquad f_c = 12\, f_o$$

EPS-7257-O





DS1102

1101
BACK
VECTOR

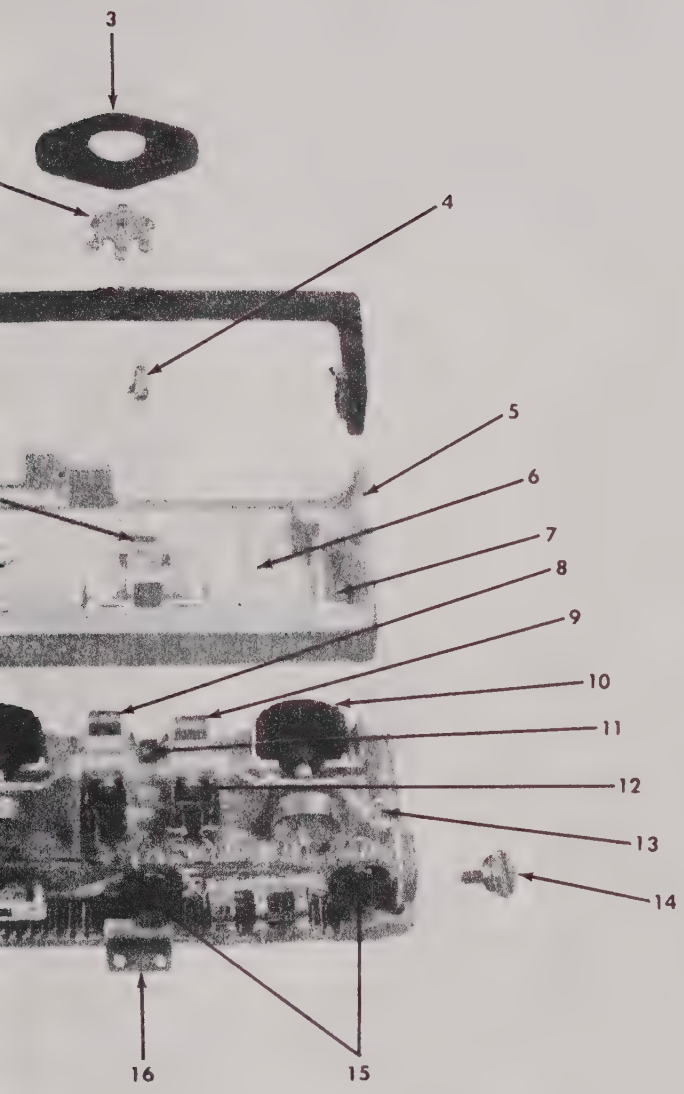
DEPS-6050-A

CONTROL HEAD

PARTS LIST SHOWN ON
BACK OF THIS DIAGRAM

"A" Suffix Control Head
Schematic Diagram and
Circuit Board Detail
Motorola No. 63P81008E72-A
8/26/71-RS

MICOR MOBILE



REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

PARTS LIST

IMPORTANT

USE ONLY THE FOLLOWING MOTOROLA PART NUMBERS WHEN ORDERING REPLACEMENT PARTS

TCN1091A Control Head (1-Freq.)
TCN1092A Control Head (2-Freq.)

PL-865-A

		LAMP, miniature: wedge base
DS1101	65B83554G01	12 V; 0.19 A; type No. 161
DS1102	65B83554G01	12 V; 0.19 A; type No. 161
		RESISTOR, fixed: ±10%: unl. stated
R1101	17D83122D03	56 ±5%; 2 W
R1102	6S6291	560; 1/2 W
R1103	6S5581	3.3K; 1/2 W
R1104	6S5581	3.3K; 1/2 W
R1105	18C84584A02	var: 25K
R1106	18C84584A02	var: 25K
		SWITCH, slide
S1101	40C84622B02	dpst (ON-OFF)
S1102	40C84622B01	spst
S1103	40C84622B03	spdt (F1-F2) TCN1092A only
	NON-REFERENCED ITEM	
	TLN4369A	PRINTED CIRCUIT BOARD ASS'Y; incl. ref parts R1101 thru R1106, S1102 and 29B84547B01 TERMINAL, pin male; 47 req'd

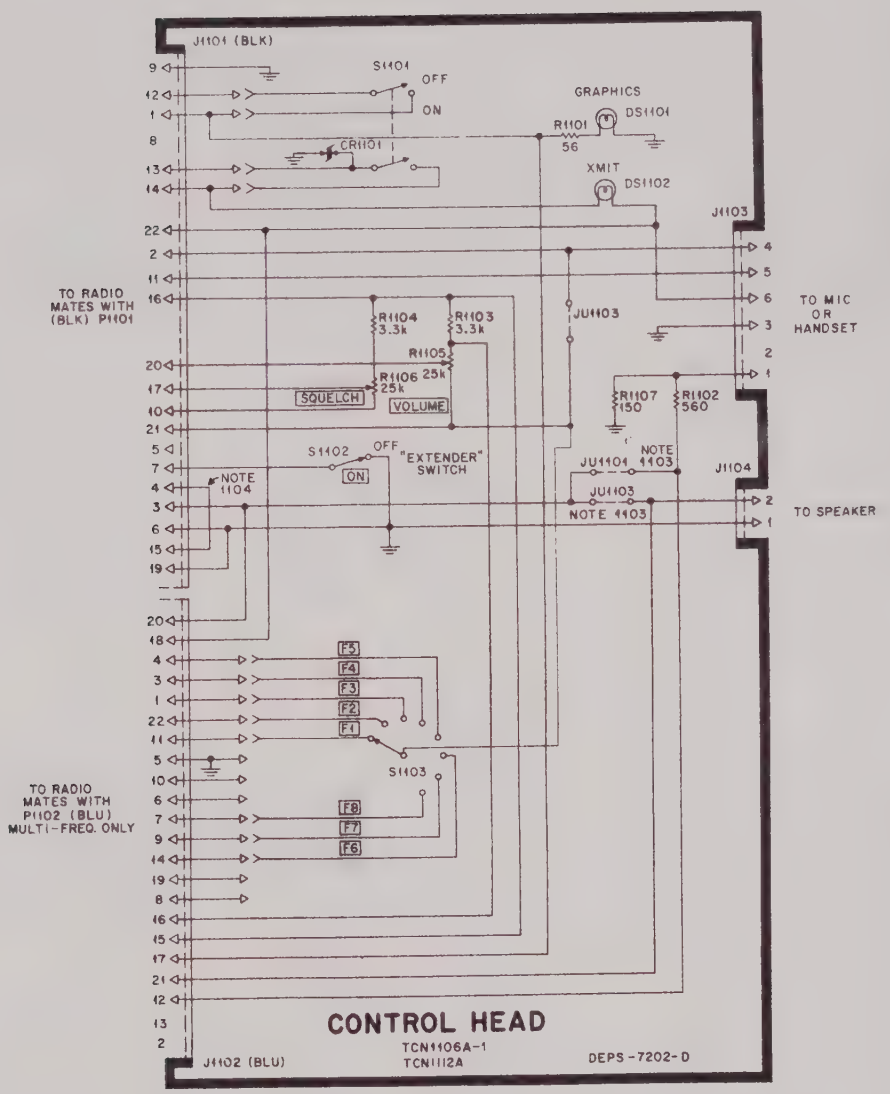
PARTS LIST

IMPORTANT

USE ONLY THE FOLLOWING MOTOROLA PART NUMBERS WHEN ORDERING REPLACEMENT PARTS

PL-866-O

CODE	MOTOROLA PART NO.	DESCRIPTION
1	7C84576B01	BRACKET, trunnion
2	49B84592B01	DISC, breakaway
3	42C84591B01	RETAINER, control head
4	3S115727	SCREW, lock: No. 10-32 x 1/2"
5	15E84572B01	COVER, top
6	1C84670B02	PRISM, optical (Volume) CLEAR
7	1B84673B01	PRISM, optical (Xmit) RED
8	1C84672B02	ACTUATOR (F1) CLEAR
9	1C84672B01	ACTUATOR (ON) CLEAR
10	36C84551B01	KNOB, control: 2 req'd
11	41B84575B01	SPRING, detent
12	3S129841	SCREW, machine: No. 4-40 x 1/4"
13	3B84548B01	SCREW, captive: 2 req'd
14	3B84546B01	SCREW, special: 2 req'd
15	9B84627B01	LAMPHOLDER (baseless) 2 req'd
16	7B84629B01	BRACKET, cable
17	15E84573B01	COVER, bottom
18	1C84670B01	PRISM, optical (SQUELCH) CLEAR
19	1C84671B01	PRISM, optical (OFF-F2) CLEAR
20	3S129841	SCREW, machine: No. 4-40 x 1/4"
21	13D84574B01	BEZEL (1-Freq.)
21	13D84574B02	BEZEL (2-Freq.)



OL-DEPS-7281-B

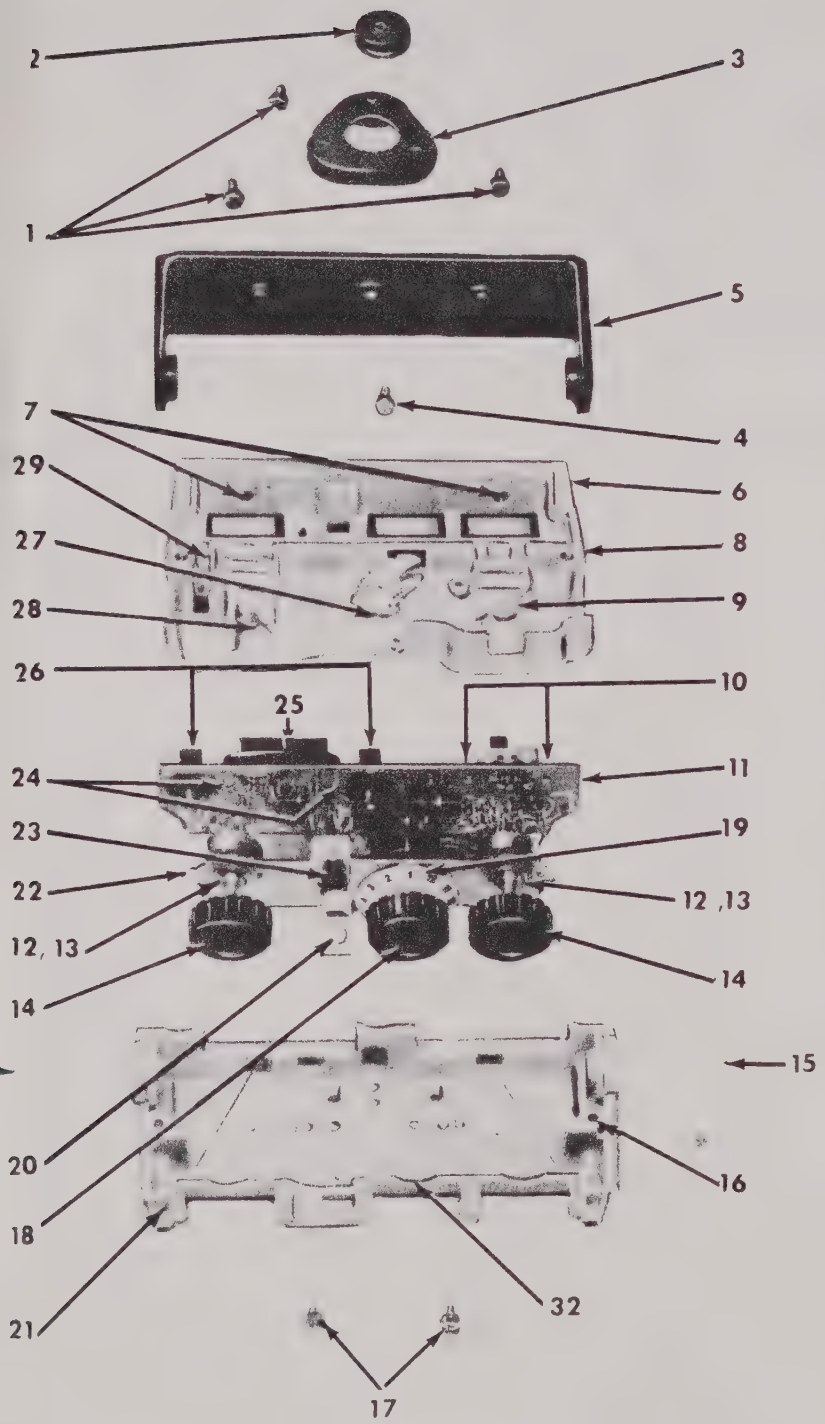
NOTES:

1. FOR PROPER OPERATION OF THIS CONTROL HEAD WITH HANDSET (TMN6057A) AND HANDSET HANG-UP SWITCH BOX (TLN4504A) REFER TO THEIR RESPECTIVE MANUALS.

2. FOR PROPER OPERATION OF THIS CONTROL HEAD WITH VOICE PRIVACY ADAPTER (TLN1400A) REFER TO VPA MANUAL.

EPS-6944-O

STANDARD HEAD.



MECHANICAL PARTS LIST

IMPORTANT

USE ONLY THE FOLLOWING MOTOROLA PART NUMBERS WHEN ORDERING REPLACEMENT PARTS

TCN1112A Control Head
TCN1106A Control Head

PL-1517-A

CODE NUMBER	MOTOROLA PART NO.	DESCRIPTION
1	3-136756	SCREW, tapping: 10-16 x 5/8" plain hex flanged head; does not include 4-7652 LOCK-WASHER; No. 10 external
2	49-84961C01	DISC, trunnion bracket mounting; "breakaway" type
3	42-84963C01	COLLAR, trunnion bracket mounting
4	3-115727	LOCKSCREW, machine; 10-32 x 1/2" plain hex head
5	7-84576B01	BRACKET, trunnion
6	75-84628B01	FRONT COVER, housing ("bumper")
7	3-136963	SCREW, tapping; 6-20 x 5/16" "Phillips" flat head
8	1-80712B88	TOP COVER ASSEMBLY, housing; includes items coded 6, 7, 9, 27, 28, 29, 31
9		PRISM, optical (SEE NOTE)
10	3-129675	LOCKSCREW, 4-40 x 1/4" "Phillips" binder head with lockwasher
11	TLN4369B	PLATED CIRCUIT BOARD ASSEMBLY; includes contact terminals
12	2-136272	NUT, machine; 3/8-32 x 1/2" hex
13	4-8210	WASHER, metallic; 0.39" x 0.562" x 0.16"
14	36-84001C02	KNOB, control (volume & squelch)
15	3-84546B01	SCREW, machine; shoulder type (trunnion-mount)
16	3-84548B01	SCREW, machine; 6-32 x 1/2" "Phillips" round head; "captive" type
17	3-136138	LOCKSCREW, machine; 6-32 x 3/8" "Phillips" hex head (TCN1106A)
	or 3-138717	SCREW, tapping: 6-20 x 3/8" (TCN1112A)
18	36-84001C01	KNOB, control; (freq. selector) (requires use of item coded 19)
19	36-84006C01	DISC, switch position indicator (used with item coded 18)
20	45-84004C01	ACTUATOR, switch
21	15-84920B01	HOUSING, (bottom section)
22	7-84005C01	BRACKET (chassis)
23	1-80712B89	SWITCH ASSEMBLY: (slide switch); includes wires, contact terminals and mounting screws
24	3-135084	LOCKSCREW, tapping: 4-40 x 5/16" "Phillips" fillister head
25	42-84067C01	RETAINER, connector
26	9-84627B01	LAMPHOLDER
27		PRISM, optical (SEE NOTE)
28		PRISM, optical (SEE NOTE)
29		PRISM, optical; includes RED LENS (SEE NOTE)
30	13-84000C01	BEZEL (single-frequency)
	or 13-84000C02	BEZEL (multi-frequency)
31	33-84038C01	MARKER STRIP (VOLUME, SQUELCH)
32	38-84357C01	PLUG, SNAP-IN (single-frequency)
33	42-84962C01	RETAINER, connector

CODE NUMBER	MOTOROLA PART NO.	DESCRIPTION
NON-REFERENCED ITEM		
	54-84111D01	MOUNTING TEMPLATE

NOTE:

Items coded 9, 27, 28 and 29 are not individually replaceable. For field-replacement, order item No. 8 (TOP COVER ASSEMBLY).

ELECTRICAL PARTS LIST

TCN1112A Control Head
TCN1106A Control Head

PL-1516-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		SEMICONDUCTOR DEVICE, diode:
CR1101	48-83461E45	Zener type
		LAMP, incandescent: miniature wedge base:
DS1101	65-83554G01	12 V; 0.19 A; type No. 161
DS1102	65-83554G01	12 V; 0.19 A; type No. 161
		CONNECTOR, receptacle:
J1101		c/o (20) 29-84547B01 TERMINALS, pin: male
J1102		c/o (20) 29-84547B01 TERMINALS, pin: male
J1103		c/o (5) 29-84547B01 TERMINALS, pin: male
J1104		c/o (2) 29-84547B01 TERMINALS, pin: male
		RESISTOR,
R1101	6-488090	fixed: 56 ±10%; 2 W
R1102	6-6291	fixed: 560 ±10%; 1/2 W
R1103	6-5581	fixed: 3.3k ±10%; 1/2 W
R1104	6-5581	fixed: 3.3k ±10%; 1/2 W
R1105	18-84584A02	variable: 25k ±30%; 1/4 W
R1106	18-84584A02	variable: 25k ±30%; 1/4 W
R1107	6-6373	fixed: 150 ±10%; 1/2 W
		SWITCH:
S1101	40-84622B02	slide: dpst; does not include 29-10134A48 LUG, connector: female; 4 req'd
S1102	40-84301C01	slide; spst
S1103	40-84149C02	rotary; 4-position; non-shorting adjustable limiting stop (TCN1106A)
	or 40-84149C01	rotary; 4-position; non-shorting adjustable limiting stop (TCN1112A)
NON-REFERENCED ITEM		
	TLN4369B	PRINTED CIRCUIT BOARD ASSEMBLY; includes 29-84547B01 TERMINAL, contact: male: 47 req'd. 42-84962C01 RETAINER, connector: 2 req'd.

CONTROL HEAD FOR "MICOR" RADIO

TCN1092B Control Head

MODEL TABLE

MODEL NUMBER	NO. OF FREQUENCIES
TCN1091B	1
TCN1092B	4
TCN1095A	1
TCN1096A	4
TCN1106A	8
TCN1112A	8
TCN1119A	12
TCN1124A	12
TCN1184A	5

TECHNICAL CHARACTERISTICS

Dimensions (excluding mounting bracket)	6-7/8" wide x 2" high x 3-3/4" deep
Weight	1 pound
Temperature Range	-30°C to +60°C
Current Drain	145 mA @ 13.8 V
Safety	Meets or exceeds Federal Safety Standards FS-201 & SAEJ921

1. DESCRIPTION

These Motorola mobile radio control heads are durable units providing ease of operation, illuminated labelling of controls (graphics), maintenance-free circuitry, and impact safety. A rugged circuit board eliminates virtually all wires, while a slide-switch, two potentiometers, and a rotary switch provide almost complete operator control of the radio set. A durable two-piece plastic housing encloses the circuit board and control head components while a resilient front bumper provides protection during accidental contact. For test purposes, an "Extender" switch is provided on the rear of the control head. This switch should be left in the ON position (inboard) during normal operation.

The recessed knurled VOLUME, frequency selector, and SQUELCH knobs project both above and below to permit adjustment by the operator. The power switch on-off actuator projects from the top when in the on position, below when off. Rotation of the frequency selector knob (multi-frequency models only) selects the desired receive and transmit frequency. The channel selected is numerically indicated on the frequency indicator dial directly above the selector knob. Rotation of the VOLUME control clockwise increases the volume. Clockwise rotation of the SQUELCH control increases the squelch threshold (requires a stronger signal before audio is heard). Labelling of controls is provided by visual graphics which are visible in the daylight and illuminated at night, while the red transmit indicator will be seen whenever the push-to-talk function is activated.

MOTOROLA INC.
Communications Division

service publications
1301 E. Algonquin Road, Schaumburg, IL 60196

AL PARTS LIST

RTANT

LOWING MOTOROLA
WHEN ORDERING
ENT PARTS

TCN1106A (8-Freq.)
TCN1112A (8-Freq.)
TCN1119A (12-Freq.)
TCN1124A (12-Freq.)
TCN1184A (5-Freq.)

PL-1048-I

DESCRIPTION
SCREW, tapping; 10-16 x 5/8" plain hex flanged head; does not include 4S7652 LOCKWASHER; No. 10 external
DISC, trunnion bracket mounting; "breakaway" type (TCN1091B and TCN1092B)
COLLAR, trunnion bracket mounting (TCN1091B, TCN1092B)
LOCKSCREW, machine; 10-32 x 1/2" plain hex head (TCN1091B, TCN1092B)
BRACKET, trunnion (TCN1091B, TCN1092B)
FRONT COVER, housing "bumper")
SCREW, tapping: 6-20 x 5/16" "Phillips" flat head
TOP COVER ASSEMBLY, housing; includes items coded 5, 7, 9, 27, 28, 29, 31 (multi-freq. models)
TOP COVER ASSEMBLY, housing; includes items coded 5, 7, 9, 28, 29 and 31 (single-freq. models)
PRISM, optical (SEE NOTE)
LOCKSCREW, 4-40 x 1/4" "Phillips" binder head with lockwasher
PLATED CIRCUIT BOARD ASSEMBLY; includes contact terminals
NUT, machine; 3/8-32 x 1/2" hex
WASHER, metallic; 0.39" x 0.562" x 0.16"
KNOB, control (volume & squelch)
SCREW, machine; shoulder type "trunnion-mount)
SCREW, machine; 6-32 x 1/2" "Phillips" round head; "captive" type
LOCKSCREW, machine; 6-32 x 3/8" "Phillips" hex head
KNOB, control; (freq. selector) (requires use of item coded 19)
DISC, switch position indicator (used with item coded 18)
ACTUATOR, switch
HOUSING, (bottom section)
BRACKET (chassis)
SWITCH ASSEMBLY: (slide switch); includes wires, contact terminals and mounting screws
LOCKSCREW, tapping; 4-40 x 5/16" "Phillips" fillister head
RETAINER, connector
LAMPHOLDER
PRISM, optical (SEE NOTE)
PRISM, optical; includes RED LENS (SEE NOTE)
BEZEL (single-frequency)
BEZEL (multi-frequency)
MARKER STRIP (VOLUME, SQUELCH)
PLUG, SNAP-IN (single-freq.)
RETAINER, connector

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
NON-CODED ITEM		
	54B84111D01	MOUNTING TEMPLATE (TCN1091B, TCN1092B)

NOTE: Items coded 9, 27, 28 and 29 are not individually replaceable. For field-replacement, order item No. 8 (TOP COVER ASSEMBLY).

ELECTRICAL PARTS LIST

PL-1049-F

CR1101	48D83461E45	DIODE: SEE NOTE diode; Zener type; nom. 25 V
		LAMP, incandescent: miniature wedge base:
DS1101	65B83554G01	12 V; 0.19 A; type No. 161
DS1102	65B83554G01	12 V; 0.19 A; type No. 161
		CONNECTOR, receptacle:
J1101		c/o (20) 29B84547B01 TERMINALS, pin: male
J1102		c/o (20) 29B84547B01 TERMINALS, pin: male
J1103		c/o (5) 29B84547B01 TERMINALS, pin: male
J1104		c/o (2) 29B84547B01 TERMINALS, pin: male
		RESISTOR:
R1101	6S488090	fixed: 56 ±10%; 2 W
R1102	6S6291	fixed: 560 ±10%; 1/2 W
R1103	6S5581	fixed: 3.3k ±10%; 1/2 W
R1104	6S5581	fixed: 3.3k ±10%; 1/2 W
R1105	18C84584A02	variable: 25k ±30%; 1/4 W
R1106	18C84584A02	variable: 25k ±30%; 1/4 W
R1107	6S6373	fixed: 150 ±10%; 1/2 W
		SWITCH:
S1101	40C84622B02	slide: dpst; does not include 29S10134A86 LUG, connector: female; 4 required
S1102	40C84301C02	momentary slide; spst
S1103	40C84149C01	rotary; 4-position; non-shorting adjustable limiting stop
	40C84149C02	rotary: 8-position; non-shorting adjustable limiting stop
	40C84149C03	rotary: 12 position; non-shorting
NON-REFERENCED ITEMS		
	TLN4369B	PRINTED CIRCUIT BOARD ASSEMBLY: includes 29B84547B01 TERMINAL, contact; male; 47 required 42C84962C01 RETAINER, connector; 2 required

NOTE:
Replacement diodes must be ordered by Motorola part number only for optimum performance.

AEPS-6971-O

MODEL CHART

MODEL	CHANNELS	APPLICATION
TCN6108AJ, BJ	1-4	Non-Reverting
TCN6146A	1-8	Non-Reverting
TCN6109AJ, BJ	1-4	Automatic Channel Reverting
TCN6148A	1-8	
TCN6108AK, BK	1-4	Non-Reverting, "Private-Line" Tone-Coded Squelch
TCN6147A	1-8	
TCN6109AK, BK	1-4	Automatic Channel Reverting, "Private-Line" Tone-Coded Squelch
TCN1057AJ, BJ	1-4	Single-Tone
TCN1099A	1-8	Single-Tone
TCN1100A	1-4	Single-Tone, Reverting

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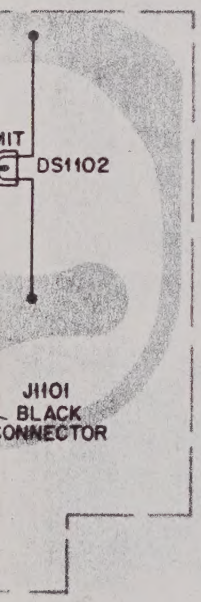
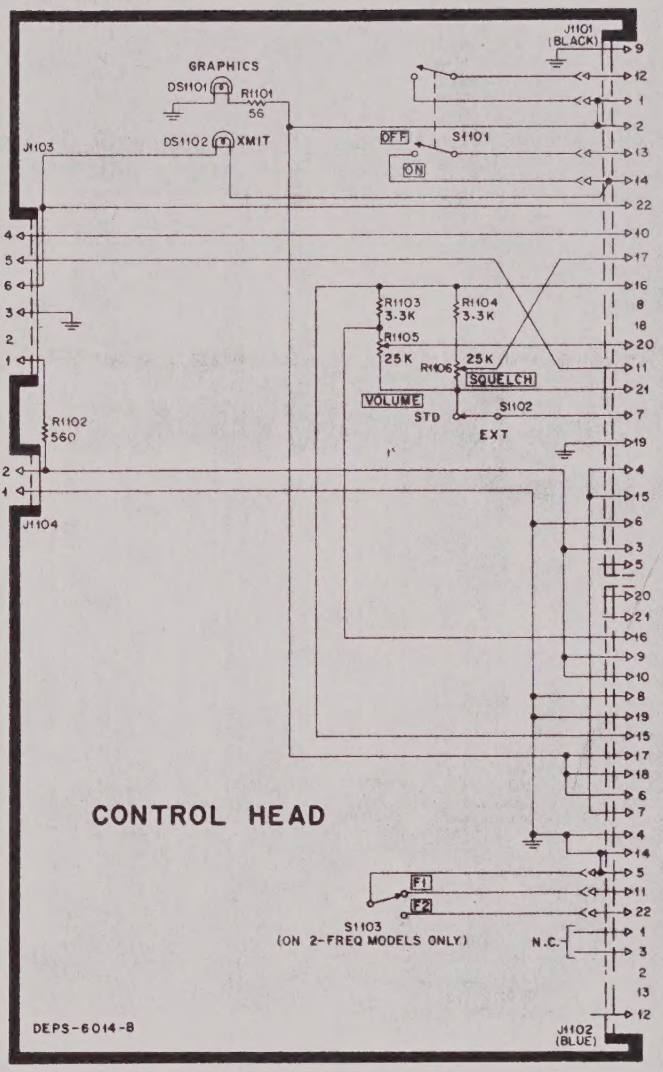


-DEPS-6049-0

L-DEPS-6050-A



CONTROL HEAD

PARTS LIST SHOWN ON
BACK OF THIS DIAGRAM

"A" Suffix Control Head
Schematic Diagram and
Circuit Board Detail
Motorola No. 63P81008E72-A
8/26/71-RS

MICOR MOBILE